

# ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

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SURGICAL RELATIONS OF THE SYMPATHETIC NERVOUS SYSTEM.....	641
GEORGE P. MULLER, M.D. ....	PHILADELPHIA, PA.
SURGICAL TREATMENT OF UNILATERAL PULMONARY TUBERCULOSIS.....	652
EDWARD ARCHIBALD, M.D. ....	MONTREAL, CANADA
TUBERCULOSIS OF THE BREAST.....	661
DAN COLLIER ELKIN, M.D. ....	BOSTON, MASS.
TUMORS OF THE BREAST—INNOCENT AND MALIGNANT.....	668
ALEXANDER PRIMROSE, C. M., EDIN. ....	TORONTO, CANADA
RANULA.....	681
VILRAY P. BLAIR, M.D. ....	St. LOUIS, MO.
FACTORS OF SAFETY IN THYROID SURGERY .....	685
WILLARD BARTLETT, M.D. ....	St. LOUIS, MO.
PATHOLOGICAL FRACTURE OF THE NECK OF THE FEMUR .....	689
ISADORE ZADEK, M.D. ....	NEW YORK, N. Y.
INVOLVEMENT OF THE LYMPH GLANDS IN CANCER OF THE CÆCUM.....	698
W. MCK. CRAIG, M.D. AND WM. C. MACCARTY, M.D. ....	ROCHESTER, MINN.
CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD.....	711
CHARLES HERBERT PHIFER, M.D. ....	CHICAGO, ILL.
SARCOMA OF THE OMENTUM .....	721
GLOVER H. COPHER, M.D. ....	St. LOUIS, MO.
CONGENITAL DIAPHRAGMATIC HERNIA .....	725
JOHN F. CONNORS, M.D. AND WM. T. ROBINSON, M.D. ....	NEW YORK, N. Y.
NON-OPERATIVE TREATMENT OF DISPLACED SEMILUNAR CARTILAGES.....	729
DOUGLAS GRAHAM, M.D. ....	BOSTON, MASS.
FRACTURES OF THE FEMUR IN CHILDREN .....	736
CARL G. BURDICK, M.D. AND IRWIN E. SIRIS, M.D. ....	NEW YORK, N. Y.
TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY.....	754
JOINT MEETING WITH THE PHILADELPHIA ACADEMY OF SURGERY HELD JANUARY 24, 1923	
STATED MEETING HELD FEBRUARY 14, 1923	
CORRESPONDENCE: <i>Hallahan</i> : Treatment of Traumatic Synovitis; <i>Ware</i> : Gonococcus Myositis; <i>Sorens</i> : Prevention of Fat Necrosis in Incisions; <i>Pennington</i> : Aluminum Potassium Nitrate in Osteomyelitis.....	781
INDEX .....	785

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# ANNALS *of* SURGERY

VOL. LXXVII

JUNE, 1923

No. 6

## SURGICAL RELATIONS OF THE SYMPATHETIC NERVOUS SYSTEM\*

BY GEORGE P. MULLER, M.D.

OF PHILADELPHIA, PA.

MUCH might be written upon the relations of the sympathetic nervous system to abdominal diseases and their symptoms. The greater part of the sympathetic ganglia are massed in the abdomen, the most important actions of the vagus nerve, except its influence on the heart, are exerted there, and in the pelvis we have the sacral autonomic. Beginning a number of years ago with the appearance of the monograph of Eppinger and Hess and continuing to the present day, attempts have been made to rewrite physiology and pathology upon the basis of vagotonia and sympatheticonia. Something has been gained, but as Carlson<sup>1</sup> well says, "The uncritical use of these terms in the sense of established etiology of well-known disease complexes retards medical progress." Alvarez<sup>2</sup> believes that while the theories of vagotonia and sympatheticonia may eventually prove useful, he thinks that the foundations are so shaky that some day the whole edifice is going to go. As Alvarez puts it, we should learn from Gaskell and others the lesson that the sympathetics are not separate and distinct brain systems, but are there to conduct and not to exercise faculties requiring almost human intelligence. "There are times when the animal as a whole needs to communicate with its digestive tract; there are times also when one end of the tract must communicate with the other; and on all these occasions the extrinsic nerves come into play. The vagi carry feelings of hunger and of satiety from the stomach to the brain; they help in adjusting the tone of the stomach wall to the food coming down the oesophagus; and they carry the stimuli that give rise to the psychic secretion of gastric juice. If the food must be rejected by vomiting, they carry the impulses which bring the abdominal muscles to the aid of the stomach. Moreover, they probably carry messages from the digestive tract which make the animal feel comfortable and sleepy. The splanchnics serve largely to quiet the tract and to stop digestion when the body is distressed or injured. The extrinsic nerves probably have much to do with the digestive upsets with disease elsewhere in the body, but these changes can be accounted for also by actual damage to the gastrointestinal muscle."

\* Annual Oration before the Philadelphia Academy of Surgery, December 4, 1922.

Some years ago, enthusiastic over Eppinger and Hess, I tried to work out a complex which would distinguish a free and supposedly chronically diseased appendix from one adherent to the parietal peritoneum or cæcum, based on purely vago-phenomena of the former, but my analysis was not fruitful. I am not sure that the vagus control stops at the end of the ileum and furthermore an irritated ascending colon will produce spasm of the ileo-cæcal valve and imitate the vagotonic group of symptoms.

Abdominal pain and discomfort constitute the keynote of the group of symptoms characteristic of surgical abdominal disease, and it is a commonplace for us to say that in the area supplied by the sympathetic network there is no pain, that the liver, intestines, stomach or other viscera may be touched, cut, pinched or burned and yet not feel pain. Head,<sup>3</sup> in a most interesting paper published recently, calls our attention to the fact that so long as the internal organs are discharging their functions normally the afferent impulses which they may originate do not enter consciousness. Internal surfaces are unable to respond to such artificial stimuli to which they have never been exposed during the life of the individual or race. But the hollow viscera, such as the stomach and the bladder, react briskly to changes in tension, which are their natural mode of stimulation. Hyperacute or long-continued visceral irritations may overcome the resistance of the higher centres and sensation follows. Head applies this reasoning to appendicitis. "In the early stages before perforation has taken place, widespread pains may be present in the abdomen corresponding to the afferent supply of the upper parts of the digestive tract. Such pains are due to abnormal movements of the stomach and intestine and express the reaction of normal parts to a lesion situated in some allied physiological system." When perforation occurs these phenomena are replaced by the local manifestations.

Spasm is the most important physiological phenomenon resulting from intra-abdominal irritation and the familiar pylorospasm is the most conspicuous example. Surgical treatment aims to remove such irritation and relieve spasm, as after appendicectomy, gall-stone operations or gastro-enterostomy. A more direct method of attack has been proposed by Braun,<sup>4</sup> who advocates division of the gastro-hepatic and gastro-colic omenta in the region of the pylorus to alleviate painful stomach spasm. Enterospasm may occur and I have operated on at least two patients suffering from acute abdominal pain in which a contracted segment of the small intestine several feet in length was the only finding. In one case it relaxed and dilated while I was handling it. A third patient had contraction of nearly the whole length of small intestine following a gunshot wound with a perforation. The relation which such conditions bear to the vagus and sympathetic, the action of the pelvic sympathetic on the bladder and uterus and so on, are of interest and importance, but I must pass over this vast chapter. I have had two cases of automatic bladder after complete destruction of the spinal cord in the dorsal region. The patients are able periodically to empty the bladder,

although voluntary control is lost. That this does occur often is due to the coincident cystitis interfering with bladder action.

From the standpoint of operative surgery little is done directly to the abdominal sympathetics. A new method of local anæsthesia has been introduced by Kappis and others whereby the splanchnics are blocked by injecting the semilunar ganglia. Let us next consider the peripheral sympathetics.

*Resection of the Cervico-thoracic Nerve.*—This operation, advocated principally by Jonnesco, was at first performed for the treatment of epilepsy, but was then applied to the cure of exophthalmic goiter, migraine, trifacial neuralgia, glaucoma, and recently to angina pectoris. As done by Jonnesco the entire nerve is removed except in glaucoma, where only the superior ganglion is resected.

*Epilepsy.*—Cervical sympathectomy proved a failure as a treatment for epilepsy. The anatomical basis for the operation rested on the fact that the superior cervical ganglion is connected by post-ganglionic fibres with the blood-vessels of the brain, the constrictor fibres probably following the course of the internal carotid artery. A number of deaths attended the operation not only in epilepsy, but in goiter and other diseases, and a probable cause has been brought out recently by Orr and Sturak,<sup>5</sup> who found distinct lesions consisting of a paralysis of vessels in the cerebral cortex, Ammon's horn, amygdaloid nucleus and pyriform lobe after section of the cervical sympathetic. A new operation recently suggested by Fisher<sup>6</sup> probably is destined also to the limbo of useless procedures. He advanced the theory that a reduction of the adrenal substance in the body would reduce the tendency to convulsions. Accordingly, adrenalectomy has been performed about thirty times by four or five German surgeons, but the results were disappointing. More important than epilepsy is the relation of the sympathetics to goiter.

*Goiter.*—It has long been known that the sympathetic nerve supply of the thyroid gland follows the superior thyroid artery, and Drobnik<sup>7</sup> believes that nerves are given off from the second cervical ganglion uniting with the first cardiac nerves and then sending branches along the inferior thyroid arteries. Jaboulay, Jonnesco and others some years ago advocated the removal of the cervical sympathetics for exophthalmic goiter but the operation has never met with support. Ligation of the superior vessels is regarded by many surgeons as not only favoring anæmia, but also as a means of cutting off the sympathetic supply. Crile<sup>8</sup> states that "the greater part of the benefit from ligation is the result of a break in the nerve supply of the thyroid since the principal sympathetic nerves run in the walls of the superior thyroid arteries." Recently, Odermatt<sup>9</sup> reports the results of a study of the sensations experienced during ligation of the thyroid vessels. If the artery was dissected bare, ligation was painless. If periarterial tissue remained, the ligation pain was constant in the anterior branch of the superior thyroid artery but inconstant in the posterior branch of the superior thyroid and in the inferior thyroid. Leriche<sup>10</sup> practised superior thyroid sympathectomy on one side in a case of goiter and noted a remarkable regression in its size. He also<sup>11</sup>



speaks of supplementing this operation in toxic cases with tachycardia by resection of the superior cardiac nerves, and of the control of the exophthalmos by pericarotid sympathectomy. Some years ago I performed bilateral removal of the superior cervical ganglion for persisting exophthalmos, but while some improvement was noted the patient did not consider the result as satisfactory.

*Glaucoma.*—I also, in one case, removed the upper ganglion for acute glaucoma, but the operation failed to save the eye. A number of years ago this was thought justifiable and Wilder<sup>12</sup> collected sixty-eight cases with good results in the majority, especially in the chronic form. The operation seems to be rarely done at present and De Schweinitz<sup>13</sup> does not advocate it.

*Optic Atrophy.*—Sympathectomy has been performed for this condition by Abadie,<sup>14</sup> who resected one centimetre of the carotid sheath to interrupt the sympathetic innervation. The atrophy in his case was characterized by a restriction of the visual field on the nasal side. The immediate results were brilliant, the visual field becoming normal in approximately two weeks, but two months after the operation the condition retrogressed until about the same as before operation. Ligation of the carotid was followed by similar transient improvement.

*Parotid Fistula.*—In 1914, Leriche<sup>15</sup> proposed resection of the auriculo-temporal nerve to suppress parotid secretion, based on Bernard's observation that this nerve is the secretory nerve for the parotid gland. The operation has been endorsed by Dieulafe,<sup>16</sup> Weitz,<sup>17</sup> Tromp<sup>18</sup> and others, but Cole<sup>19</sup> condemns the operation by comparing it to the plumber who would repair a leaky pipe by cutting off the water supply of the house.

*Angina Pectoris.*—Without attempting any argument of the somewhat obscure etiology of this disease, I can recount the attempts at its cure, or rather amelioration, by surgical measures. In 1916, Jonnesco<sup>20</sup> removed the middle cervical ganglion, the sympathetic trunk, the plexuses about the inferior thyroid and vertebral arteries, the inferior cervical and first thoracic ganglia of the left side in a case of typical angina pectoris. Four years later he examined the patient and reported the case. During the subsequent four years the patient had no attack of angina and follows his occupation as a clerk. The cardiac action, pulse and respiration were found normal. X-ray examination showed a slight dilatation of the aorta with thickening and a broadening of the heart shadow. This report was followed by the report of another case. The second patient operated on by Jonnesco<sup>21</sup> was fifty-four years old and for eight years had suffered from attacks of suffocation and from paroxysms of pain radiating to the cervical region and left arm. The left cervico-thoracic nerve was resected and marked improvement was noted during the ensuing four months. Jonnesco apparently believes that the phenomena of angina pectoris are due to irritation of the terminal filaments of the nerves of the sympathetic plexus in the walls of a chronically inflamed aorta. He only resected the left side because the patient refused to go further, and was surprised at the completeness and permanence of the relief.

## RELATIONS OF SYMPATHETIC NERVOUS SYSTEM

Jonnesco's operation has brought to light another case, namely that of Renon, who had a woman patient with aneurism of the aorta which was discreet and fusiform. The case was referred to Tuffier,<sup>22</sup> who exposed the aorta by a transverse division of the sternum and wrapped the length of the aneurism with a strip of fascia lata. Renon concluded that there was some amelioration of symptoms and the general state better, but I would judge that the operation actually accomplished little. However, in the discussion of this case Delorme pointed out that the act of freeing the aneurism caused the division or removal of the sympathetic plexuses, which really supplied the reason for the relief of pain. In a later paper Delorme<sup>23</sup> suggests that sympathectomy would be worth while as an effort to relieve the pains of aortitis.

*Periarterial Sympathectomy.*—In 1913, Leriche published his first communication and since then about twenty others have appeared from this surgeon alone. The technic of the operation is well known and consists in the removal of 8 or 10 cm. of the adventitia of the artery. While the stripping is in progress a marked contraction of the artery is noted, followed by a peripheral dilation which becomes attenuated in five or six days and disappears after three or four weeks. This vasodilation, according to Leriche, is the therapeutic effect of the operation, but Bruening and Stahl<sup>24</sup> believe that the hyperæmia is not the only factor at work in producing beneficial results from sympathectomy. There is a transposition of the entire vascular function as a result of the interruption of the normal sympathetic stimulation. The autonomous nature of the vascular nerve apparatus explains the return to normal after a brief period of vasodilation. Handley<sup>25</sup> very recently has published a substitute method for sympathectomy as performed by Leriche. After exposing the artery he injects four minims of alcohol at each of four equidistant points around the circumference of the vessel, the needle being introduced obliquely into the tunica adventitia. Two cases were injected, both of actual gangrene. In the first there was recession of the line of gangrene and the formation of new lines of demarcation around the toes. In the second, an unfavorable case, the operation brought but slight benefit but definitely accentuated the vasodilation already present. Handley believes his method superior to the original one because it is simpler to perform, does not produce the initial stage of vasoconstriction and attains immediately the vasodilator results aimed at by the operation. As usual we have a German claim for priority in the discovery of this operation in the person of Heinrich Highier.<sup>6</sup>

In his article in the *ANNALS OF SURGERY* last year, Leriche<sup>27</sup> reports that he has performed sympathectomy sixty-four times for various affections, sometimes with remarkable success and sometimes with complete failure. Many other cases are recorded in the literature and I myself have had the opportunity to do this operation thirteen times on eleven patients. The anatomical aspects of the operation are rather interesting. The arterial sympathetics are probably remains of the primitive nerve nets of the low

scale animal and perhaps act as "booster" stations for the vasomotor impulses coming in from the somatic nerves. How much autonomy they may have is not clear. They are situated in the adventitious tunic of the artery. The vasomotor innervation of the arteries of the extremities is made possible by the re-entry into the spinal roots of sympathetic fibres by way of the gray rami communicantes; they intermingle with other afferent and efferent fibres and pursue a straight course to the periphery. Along the course of the peripheral nerves twigs are given off from time to time which connect with or form the sympathetic net on the blood-vessels. But little information is given in the text-books regarding these twigs and our knowledge is rather scanty.

*The Nerves to the Arteries.*—In 1914, some observations from the Western Reserve University were published which sum up and add to the existing knowledge. Kramer and Todd<sup>28</sup> investigated the nerve supply to the arteries of the arm and found that the subclavian and proximal part of the axillary arteries received a nerve supply directly from the sympathetic chain, between or including the middle and inferior cervical ganglia which reached the artery in the interval between the scalenus anticus and the bone. The portion of the subclavian artery immediately adjacent to its origin was supplied by a varying number of twigs from the musculo-cutaneous nerve, the radial from the superficial ramus of the radial nerve and the ulnar from the ulnar nerve in the forearm. Todd and Kramer point out that, "the more distal arteries are supplied by sympathetic fibres which have travelled to their distribution along special nerve-trunks and not along main vessels. These twigs are distributed to the vessels from the nerve-trunks at intervals; the intervals growing shorter as the more distal portions of the limb are reached, as though a greater wealth of nerves was needed in these parts. Possibly the diminishing size of the member and consequently the greater need for constant regulation in size of vessels may be associated with this fact. Again the distribution of nerves to vessels corresponds pretty closely with the distribution of nerves to the skin and musculature of the same area." The clinical significance of the nerve supply to the blood-vessels of the upper extremity is well illustrated in cervical rib. The symptoms of the lesion may be motor, sensory, vascular, or sympathetic. In the latter case it is not necessary that the sympathetic net on the subclavian artery must be involved because pressure on the brachial plexus may involve the sympathetic fibres reaching into the median ulnar or radial and thence to the arterial sympathetic. Todd<sup>29</sup> reported a case in 1912 with no palpable pulse, operation revealing no compression of the vessel, and in which he believes the vascular phenomena were sympathetic in origin. I think I have seen an exactly comparable case in which vascular symptoms began at the periphery and there was no palpable pulse. Sympathectomy was followed by relief of pain and the hand became warm. Later, cervical rib resection was followed by cure.

Another interesting point has been brought out by study of the arm sympathetics. Tournay<sup>30</sup> has shown that section of the sympathetic produces



## RELATIONS OF SYMPATHETIC NERVOUS SYSTEM

a reinforcement of sensation. Regard<sup>31</sup> reports a case where after suture of an ulnar nerve, sensation was restored almost immediately and vasomotor disturbances disappeared. Motion was not affected even after eight months. He explains the phenomenon by the fact that the dissection removed fibres of the sympathetic about the ulnar which permitted sensation to be transferred by the median nerve.

The distribution of nerves to the arteries of the lower extremity has been investigated by Potts.<sup>32</sup> He found that the femoral artery received branches, after its bifurcation into the superficial and deep femorals, from some independent twigs and from muscular branches of the femoral nerve; the lower part may receive a twig from the saphenous nerve. The popliteal artery is supplied by the tibial and in many cases also by the azygos nerve. The posterior tibial is richly supplied from the tibial nerve and from the nerve to the flexor hallucis longus muscle, the perineal artery is reached by the muscular branches to the popliteus and flexor longus hallucis. The anterior tibial and the dorsalis pedis receive twigs from the peroneus profundus.

Leriche divides the phenomena resulting from injury of the periarterial sympathetic plexus into two groups: In the first group the characteristic physiologic reaction is pure, with two striking aspects, painful ischæmia and consecutive vasodilation; in the second, reaction is disturbed and gives various troubles.

In the first, Leriche classes "stupeur arterielle" and Raynaud's disease. Sudden arterial spasm may occur and be so intense as to lead to gangrene. It may occur after trauma, such as fracture or in war wounds where concussion of the artery has occurred. Reichle<sup>33</sup> has noted two cases of segmental spasmodic contraction of a large vessel after trauma. If not recognized unnecessary amputations may be done. Another phase of this gangrene has been described by Oppel,<sup>34</sup> writing on spontaneous gangrene, who believes that the adrenal plays a part in its production through overaction, the increased amount of adrenin causing an ischæmia and a disturbance in the nutrition of the arterial walls. We might theorize that if this is so and if the effect of the emotions, particularly fear, is to increase the flow of adrenin, then we have a reasonable explanation of the etiology of Buerger's disease in the Russian Jew.

*Raynaud's Disease.*—First described by Raynaud in 1862, this affection is distinctly a disturbance of the vasomotor mechanism. The local syncope and the asphyxial attacks are constrictor in nature. Rarely the dilator phenomena of hyperæmia are observed. Halpert<sup>35</sup> has described in detail the capillary changes in a patient with typical Raynaud's syndrome. She found increased tortuosity of the capillaries, as well as groups of capillaries from three to five times larger than normal. The blood flow was slow. During an attack the giant capillaries became fuller, especially in their venous portion, and exhibited changes in contour, such as projections and strictures. The blood appeared to be pushed through the vessel by a peristaltic-like wave. In a severe attack the blood became completely stagnant and blue. These

observations correspond strikingly to the explanation originally offered by Raynaud. Gangrene is a terminal phenomenon and is usually characteristic. The essential features of this disease are well known and need not be repeated here. Recently Buchanan<sup>36</sup> has presented a study of the cases seen in the Mayo Clinic, sixty-seven in number.

Judging generally by the reported cases the results of treatment in this disease have not been very successful. If we agree that vasoconstriction is the predominant influence then sympathectomy causing dilation is worth while. Leriche has twice done this operation in Raynaud's disease with good results. I have performed sympathectomy on both brachials in a case of Raynaud's disease occurring in a man seventy years old. He had the characteristic "dead fingers" with other symptoms and early gangrenous patches on the skin of the hands. He was practically cured. Perhaps we are justified in adding to this group a condition known as acrocyanosis.

*Acrocyanosis.*—Many of us have no doubt noted the occurrence of cold and cyanotic hands in certain persons, particularly those of an asthenic type, and Cordier<sup>37</sup> believes that a localized arterial hypertension, especially of the hands and feet, will occur more frequently in the future as the result of "the intoxications, commotions, fatigues and latent infections" of the War. Sufferers from the so-called "irritable heart" of soldiers often exhibit acrocyanosis to a marked degree. Boas<sup>38</sup> studied twelve cases of acrocyanosis and found that "when the hands are cold and cyanotic, the capillary blood-pressure is low and the flow sluggish. This cannot be due to a constriction of the venules, but must depend on a constriction of the arterioles or a marked dilatation of the capillaries. It is significant, too, that the capillaries become fuller when the hands are warm. If the venules were constricted, the capillaries would be engorged during the period of cyanosis."

Warmth will usually accelerate the blood flow in the capillaries, but in intractable cases I would suggest the performance of sympathectomy as an experiment to note the permanency of the resulting vasodilation.

In the second group described by Leriche are placed a miscellaneous number of affections characterized by a disturbance of physiological reaction from contracture of too long duration or abnormally persisting dilatation. The only pathology noted is an adhesion of the vessels to the common sheath, or an increase of the vascularization of the adventitia. Sometimes nothing is seen. Leriche no doubt is over-enthusiastic when he ascribes disturbance of the sympathetic innervation as the cause of trophic ulcers following nerve section, but there is some ground for the opinion that it plays a part. Stopford<sup>39</sup> believes "there is strong reason to conclude that irritative nerve lesions can produce changes in the walls of the arteries supplied by the affected nerves. These changes seriously reduce the calibre of the vessel and must inevitably diminish the blood supply to the muscles, bones, joints and skin." It has been pointed out also that injury in regions remote from the large blood-vessels may be accompanied by pain or trophic disturbances, but Leriche counters by stating that with injury in a richly furnished zone

## RELATIONS OF SYMPATHETIC NERVOUS SYSTEM

of sensory innervation the vasomotor disturbances may be due to ortho- or antidromic reflexes, starting from the injured point, and referred back along the periarterial sympathetics. Much was written during the War about the effects of nerve ischæmia in wounds of arteries, and trophic, sensory, and motor abnormalities were noted. The reaction was thought to be similar to that occurring in the optic nerve after thrombosis or embolism of the central retinal artery. Ischæmic myositis after blood-vessel injuries has been discussed also by Stewart<sup>40</sup> and ischæmic paralysis well presented by Burrows.<sup>41</sup>

Physiologic research is needed to further elucidate the importance of the sympathetics in these conditions, but all in all there is much to support the claim of Leriche.

Clinically, successes have been claimed in (1) causalgia after war wounds; (2) certain painful crises preceding gangrene caused by obliterative endarteritis; (3) vasomotor trophic neuroses with contractures; (4) painful stump; (5) trophic ulcerations of stumps and extremities; (6) trophic œdema; (7) ischæmic paralysis of the forearm, etc.

In my own experience the most gratifying results, aside from the cases of Raynaud's and cervical rib already mentioned, have been in (1) a painful stump from amputation eight years previously and with almost continuous pain during that time. He had been operated on without relief six months previously. Following sympathectomy, complete relief was experienced. (2) A case of threatened or beginning gangrene of the toes with calcareous tibial arteries as shown by X-ray and marked pain, was not only cured of pain but the gangrenous areas cleared up in a most remarkable manner. I saw this man seven months later and his foot is perfectly well, except for cyanosis in the dependent position. (3) A case of tropho-neuroses with contractures and pain in the foot. Marked relief of both attended sympathectomy. One of both attended sympathectomy. One case of painful stump was a failure, two cases of Buerger's disease were slightly improved, a case of gangrene of the fingers with bilateral sympathectomy was distinctly improved. I had one fatality in an elderly woman with acrocyanosis and arteriosclerosis, following infection of the wound, hemorrhage and death after ligation of the femoral artery. Matona<sup>42</sup> reports a similar occurrence. Recently I assisted Doctor Frazier perform sympathectomy in a case of tropho-neuroses of unknown origin with burning pain and œdema of the foot, the patient being completely relieved by the operation.

It will be noted that six of the patients were cured and in one case gangrene was probably stayed; the other four must be classed as failures.

*Causalgia.*—This is a painful vasomotor neurosis resulting from irritation of a mixed nerve. It was first described by Weir Mitchell and he coined the name. From the standpoint of this paper the following from Mitchell<sup>43</sup> is of interest: "Further study led us to suspect that the irritation of a nerve at the point of the wound might give rise to changes in the circulation and nutrition of the parts in its distribution, and that these alterations might be of themselves of a pain-producing nature." Many articles on causalgia have



appeared since the War, mostly from French sources, the best article in English being, I believe, that by Carter.<sup>44</sup>

While the pain is essentially a peripheral reflection along somatic nerves, usually the sciatic or median, set up by peripheral irritation, yet the sympathetic plays a part in several ways. After division of one of these nerves pain may continue, the impulse travelling along anastomosing sympathetic fibres in a centripetal direction and thence reflecting along centrifugal fibres. Leriche believes that causalgia is due to a neuritis of the periarterial sympathetic system and not to the direct injury to the nerve trunk. But there is much evidence on record to show that causalgia may occur when no injury to the main vessel could have occurred. Potts, from his anatomical study referred to above, states that "local damage to a large artery will injure the vascular plexus at the point of damage only, but will not account for changes produced in the vessel at a distance from the injured site. If absolute proof can be obtained of the relation between damage to the sympathetic supply of an artery and morphological changes in the vessel itself of more than focal character, then the nerve damage must occur at some distance from the arterial tree, and not simply to the sympathetic plexus as it lies on the vessel."

Nevertheless theory sometimes must give way to facts. Leriche states that in causalgia after war wounds sympathectomy gave him in nine cases two complete failures, two satisfying improvements, and five excellent results. Platon<sup>45</sup> reports excellent results in eighteen cases, in sixteen the pain stopping at once and in two more gradually. The motor nerves were involved in all but two of the cases. Girou<sup>46</sup> differentiates causalgia from sympathetic irritation pain, and diagnoses the latter by the occurrence of flexion contraction of the hand, indicating a vessel lesion involving the sympathetics. You will remember that Lewis<sup>47</sup> following the suggestion of Sicard<sup>48</sup> reported three cases of causalgia treated by intraneural injection of 60 per cent. alcohol in which the patients experienced almost instant relief. He prefers this method to sympathectomy because of its simplicity.

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## THE SURGICAL TREATMENT OF UNILATERAL PULMONARY TUBERCULOSIS\*

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ONE significant example, among many, of the extraordinary progress of medical science during the last half century, is found in the history of the therapeutics of pulmonary tuberculosis. Hippocrates thought of consumption as practically hopeless, and our grandfathers regarded it in no other way. The lapse of two thousand years showed but little advance in the cure of this disease. Then, of a sudden, within the space of fifty years, appear three great landmarks of progress. Brehmer and his student, Detweiler, in the middle third of the last century, revolutionized the treatment of pulmonary tuberculosis with that method which we now call "hygienic,"—fresh air, forced feeding, and rest; and Trudeau, of Saranac Lake, brought all this to the notice of the profession in this country over thirty years ago. The second landmark was the discovery of artificial pneumothorax by Forlanini, in the eighties; and no one now disputes the extraordinary effect for good which that procedure exercises in selected cases. And now we come to the third landmark, that is, the operative treatment of such patients as remain insufficiently benefited by hygienic treatment, and in whom artificial pneumothorax is found impossible. We are not in this country accustomed to consider ourselves behind the times in matters of surgical progress; yet in this subject we are backward. It must be admitted that the rôle of surgery in this disease has been worked out almost exclusively in Germany and Switzerland. Friedrich, of Marburg, and Henschen, Sauerbruch's assistant, both read articles on this subject before this society before the war. Later came Scandinavia, England, and France, while we on this side of the water come last. It should be recalled, however, that in 1909 Freeman, of Denver, advised the resection of a few ribs anteriorly over the diseased apex, and proposed a truss for local pressure upon the indrawn area. I have found very few other references in American literature to this subject. Meyer, Shortle, and one or two others have reported isolated cases.

As a result of somewhat particular circumstances, my own interest in the problem was early aroused, and my first case dates back to 1912. The second patient came in 1914. Then the war intervened; but since 1917 I have had twenty-five other cases. It is on the basis of this material that I venture to make this communication.

The operation at present understood under the term of extrapleural thoracoplasty has been now pretty well standardized by Sauerbruch, and consists, briefly, in the resection of the first or second to the tenth or eleventh

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\* Paper read before the American Surgical Association, May 3, 1923.



## UNILATERAL PULMONARY TUBERCULOSIS

ribs, posteriorly. Various lengths of the ribs are taken out. The periosteum is usually left. The operation is always posterior, and must practically always begin over the lower lobe and be finished over the upper. It is done preferably in one stage, but very frequently in two.

The object of the operation is two-fold, on the one hand to compress the lung by the inward spring of the sectioned ribs, and on the other hand to set the lung at physiological rest. The spring of the ribs is very considerable. Often after resecting from three to four inches of any one of the middle ribs I have seen the two ends come almost together. Physiological rest of the lung is the rest from respiratory activity. The lung expands very little when it is deprived of its rib support. Rib resection acts as an actual cutting of the bond which unites respiration with thoracic movements. Consequently, if these two objects are fulfilled, the great principle of rest, which is the keynote of tuberculosis therapy, comes into full utilization.

The posterior operation nearly always brings about a large measure of improvement in the first few weeks or months. Sputum and cough are both greatly lessened, or even disappear. Fever, if previously present, is abolished; and there is a marked increase in appetite, in weight, and in the sense of general well-being. In some cases, however, this early improvement is followed by a relapse, or it remains considerably short of an ideal result. Under these circumstances, X-ray photographs will usually show the persistence of uncompressed or insufficiently compressed cavities high up in the upper lobe. The spring of the ribs in the uppermost portion of the thoracic barrel is notably less than in the middle and lower areas, and the degree of lung compression afforded by resection is correspondingly less. For such cases, the apicolysis of Tuffier (who, however, designed the operation for early lesions localized to the apex in order to spare the healthy lower lobe) will be found to be decidedly worth while though at the cost of increased risk. This operation consists in a resection of the second rib in front and a peeling off of the apex from its *loge* in the attic of the thorax, always keeping outside the parietal pleura. This is combined with the implantation of a free fat transplant, or of paraffin (Baer), or of pedicled muscle flaps (Archibald), in order to fill up the space created and maintain lung compression.

The essential indications for the operation may be set down briefly. They are, first, that artificial pneumothorax shall have been tried and found impossible, or insufficient; secondly, that there shall be no disease, or only slight disease, and that arrested, in the other lung; thirdly, that there shall be no serious disease elsewhere in the body. There is no need in this place to go deeply into particulars concerning the selection of cases. In this matter, the assistance of the expert in tuberculosis is absolutely necessary, and indeed the bulk of the patients will come from those who practise this specialty. Team work between the surgeon and the internist is perhaps of more value in this than in any other department of borderline surgery. One may say, however, that the best cases for the operation are the "chronics" in whom

destruction and fibrosis have gone hand in hand, so that Nature, though she may have already done much in the way of cure, has nevertheless come to her limit in the degree of contraction which fibrosis is able to bring about; in other words, those in whom the diaphragm is pulled up, the chest fallen in, the trachea and the heart pulled across. In such patients, as a rule, the lung contains cavities which are situated usually in the upper lobe, and are held open by the rigidity of the ribs and the fibrous adhesions of the lung and pleura to the chest wall. Such cavities, so long as they remain open, can not possibly heal; and those who carry them are, in the true sense of the word, chronics. They may go along for years more or less comfortably, leading for the most part a sanitarium existence, expectorating considerable quantities of sputum, coughing a good deal, subject to bouts of fever from time to time; but ultimately they lose resistance and go down. Their outlook is not good. Though they live one year or many years, they still expect to die soon or late, and they live in that fear.

Now, in some of these, artificial pneumothorax is able to bring about an extraordinary change for the better; but in many this procedure is found to be impossible on account of adhesions, and the only thing that remains is an extrapleural thoracoplasty. It may be said at once that the results of extrapleural thoracoplasty are very little, if at all, behind those of artificial pneumothorax. Sometimes they are even extraordinary. My own opinion is that once artificial pneumothorax has been considered, tried, and found impossible of execution, then, at that very moment, the question of surgical intervention should be considered. It is not right to throw up the sponge because air can not be got into the chest. On the contrary it is absolutely justifiable to operate, and that without delay, save for particular circumstances which may render operation inadvisable.

Considering the frail nature of the material with which we are working, it may well be asked, whether the immediate danger of operation is not so great as to be practically prohibitive? The answer is most decidedly in the negative. With proper care to avoid shock, with the use of gas-oxygen and local anæsthesia, with a right selection of cases, with attention to post-operative treatment, there will be, with the posterior operation, practically no operative mortality. Yet there are dangers! They are primary and late. The first, briefly stated, is this: too extensive a removal of ribs, as in Friedrich's method of total resection, leaves the heart unsupported, causes mediastinal flutter, paradoxical respiration with "pendulum" air, and is apt to kill the patient within the first week through failure of the heart and pulmonary œdema. My first patient, in whom, following Friedrich, I removed the whole thoracic cage on one side, was lost in this way. The second danger lies in the possible aggravation, after weeks or months, of the tuberculous disease in the "sound" lung (nearly always present, though slight and presumably arrested) as the result of the extra functional strain so suddenly thrown upon it. And if there be present in addition any mixed infection in the way of a chronic

## UNILATERAL PULMONARY TUBERCULOSIS

mild bronchitis in the sound lung, this late danger may become an immediate danger, for the mild latent bronchitis may rapidly turn into an acute infective and purulent bronchitis, and this in turn into a spreading broncho-pneumonia, against which such invalid patients as these can offer no effective resistance. In this way, I lost one more patient, whose history I shall shortly relate in greater detail.

*Results.*—The total number of patients † upon whom I have operated for unilateral pulmonary tuberculosis is fifteen, not including two in whom I did the minor operations of phrenicotomy and the cutting of intrapleural adhesions. In these fifteen a posterior thoracoplasty has been carried out, with the exception of one in whom I resected the whole side of the bony thorax according to Friedrich's plan. The ages of these patients varied from twenty-seven to fifty-five years. The duration of the illness previous to operation was from two to twenty-two years. In six the chief disease was on the right side; in nine on the left; the better lung, ordinarily called the sound lung, was slightly affected in all, and in two it was considerably affected. One patient had laryngeal and one chronic intestinal tuberculosis. The patients came to operation in what one would call poor condition in eight cases; in fair condition in four cases; and in good condition in three. The Sauerbruch operation from the second or first to the tenth rib behind was done in eleven; a total resection in one; a partial resection in three. In these last either the upper or the lower lobe was already compressed by an artificial pneumothorax, which was maintained. Following the posterior operation I have in five of the cases, gone on to the operation of apicolysis, with freeing the lung apex, and in fact, of much of the upper lobe, and the implantation of muscle flaps, according to the method which I reported some two years ago.

The results, briefly stated, are these: Three died from the operation. Of these, one followed the Friedrich operation already mentioned. This patient died from oedema of the lungs and failing heart on the sixth day. Such a fatality need never occur again. It was due to an operation now deservedly abandoned. Another died on the twentieth day from streptococcus infection, arising in a small abscess hidden under the scapula. This patient had had sixteen punctures done in the attempt to induce artificial pneumothorax. He was a chronic case, twenty years sick, hectic, with multiple cavities. The needling had perhaps drawn infection from the lung into the back muscles, and the operation may have lighted this up. The third died after a third operation; that is, an apicolysis, following the two previous ones, posteriorly, on the sixth day, from oedema of the good lung, together with acute purulent bronchitis. On the other hand, practical cures in these fifteen cases number three. By that I mean, following Sauerbruch, almost complete disappearance of sputum, disappearance of bacilli and of cough, ability to do a certain amount of work,

† These have been referred to me by Doctor Parfitt of Gravenhurst, Doctor Byers of St. Agathe, P. Q., Dr. Lawrenson Brown, the late Doctor Paterson, and Doctor Packard of Saranac Lake, Doctor Miller of Kentville, N. S., Doctor Lloyd of Rochester, N. Y., Doctor Pottenger of Monrovia, Cal., and Doctor Pratt of Boston.

and general well-being. There were markedly improved three, slightly improved two, and stationary, three. Finally, one died twenty months after operation of the progress of the disease. In two of those of the last class, called stationary, the disease progressed to some extent in the better lung but their general condition remained good. The patient who died after twenty months was from the first not very suitable for the operation, inasmuch as his disease was a diffuse, almost pneumonic infiltration of the whole lung, with very little cavitation. Such patients, showing but slight tendency to fibrosis, are in a general way not good subjects. One needs the evidence of resistance; that is of fibrosis. He was considerably improved, nevertheless, for a period of some six to eight months, by the operation.

Excluding the first case of total rib resection, an operation which should not be considered at all in any modern statistics, the percentages work out as follows:

Operative mortality .....	14	per cent.
Late mortality, from progress of disease .....	8.5	per cent.
Practical cures .....	25	per cent.
Greatly improved .....	17	per cent.
Slightly improved .....	25	per cent.
Not improved .....	25	per cent.

The series is confessedly too small to justify laying much stress upon figures; but it should be remembered that, for humanitarian reasons, several cases have been accepted who were decidedly poor risks; that all those who died from the operation belonged to this class; and finally that six were operated on less than a year ago, of whom two are already so much better as to bid fair to become "practical cures." If one takes only those who were operated on over a year ago, the percentage of practical cures rises to  $33\frac{1}{3}$ .

I may add here a short note upon the results obtained by Sauerbruch, who, in a recently published book, gives the statistics of three hundred and eighty cases, and in a more recent article adds a further series of fifty-seven. In this last series there was no death following operation before the eighth day, at which time one patient died of pneumonia. The mortality in the first four weeks was 7 per cent., while in his larger series it was 12 per cent.; 26 per cent. had lost all sputum and bacilli; 42 per cent. might be considered as improved, although still under sanatorium treatment. The remaining 25 per cent. were either unchanged or had grown worse. These figures correspond accurately enough with those of the larger series of 381 cases in which Sauerbruch got 35 per cent. of cures and 40 per cent. of definite improvement.

When it is considered, as Sauerbruch remarks, that with rare exceptions only such patients have come under surgical treatment as had for years pursued the cure in various sanatoria—patients who were seriously ill, who had cavities and also sputum containing large numbers of bacilli, one must admit that the results of operation are decidedly encouraging. Naturally, the operation in and of itself does not cure the patient; but it affords nature the opportunity,



## UNILATERAL PULMONARY TUBERCULOSIS

or the possibility, of developing further her own processes of cure, processes which had been arrested by the presence of anatomical conditions. Consequently it is obvious that sanatorium care is still necessary after operations; but whereas before operation this had come to the limit of its effectiveness, it gains through operation an increased capacity of doing good.

Lacking both time and space, I shall relate the histories of no more than two of these patients, one for warning, the other for encouragement.

*Case Reports.*—CASE I.—Mrs. McN., aged thirty-eight. Admitted to the Royal Victoria Hospital on September 29, 1920. This patient was referred to me by Doctor Pottenger of Monrovia, California.

The patient had been suffering from recognized pulmonary tuberculosis for eleven years, most of which time had been spent in sanatoria in the south west. The process had affected the whole left lung. There was extensive cavitation in both lobes, and quite enormous fibrotic contraction. There was also slight disease in the right apex and some infiltration with a possible small cavity in the right lower lobe. In July, 1920, she had what was probably an acute pleurisy of the right side, with fever up to 103, an increase of sputum from 60 to 130 c.c. and aggravation of the cough. During this illness, which lasted two weeks, she lost thirteen pounds, but recovered during the summer. There were no physical signs of the pleurisy which she apparently had had three months previously.

It was a difficult matter to decide whether one should take the risk of operating on this patient or not. The type of lesion in the left lung was certainly suitable for operation, although destruction was very great, but the presence of some disease on the right side, and the history of a probable pleurisy on that side three months before, suggesting as it did recent activity, indicated the necessity of caution. However, as she was running a practically normal temperature and a pulse of 70 to 90, and as there were no clinical signs of activity in the right side, I finally decided that the posterior operation at least might be undertaken. Accordingly on October 6th, under gas-oxygen and novocaine anaesthesia, I resected the 10th to the 6th ribs inclusive in lengths of from four to three and a half inches. The heart was felt beating very superficially under the 7th and 8th ribs, having obviously been pulled backwards by the fibrosis of the lung and adhesions to the posterior pericardium. The lung was felt diffusely infiltrated and hard in the upper third of the incision, but was softer in the lower part of the lobe. The wound healed *per primam*. On October 26th the second stage was done under the same anaesthesia, and the 2nd, 3rd, 4th, and 5th ribs were resected in lengths of from one to three inches. The heart impulse was felt quite superficially in the posterior axillary line. The whole lung was diffusely and densely thickened.

The patient stood both operations quite well, temperature rising for a few days up to 100 and pulse up to 120. Respiration was somewhat quickened, up to 30, but within a week, on each occasion, temperature and respiration returned to the pre-operative level, though the pulse remained on the average about ten beats faster. The amount of sputum, however, was not diminished, although it became somewhat less purulent and more frothy. The amount varied from three to five ounces in twenty-four hours. On November 25th, Dr. H. B. Cushing reported as follows: "General condition good but appears more nervous than formerly. No signs of increased disease in right lung. Left chest markedly collapsed, especially in lower part. Skiagrams and physical signs indicate that little effect so far has been produced on the bronchiectatic cavities grouped around the root of the left lung. Heart in about the same position as before."

On November 27th she was given an autogenous vaccine of 50,000,000 which was not followed by any particular reaction, and on December 5th another dose of the vaccine of the same amount was given. This second dose was followed by a marked reaction, which did her some harm, temperature rising to 100, pulse to 110. She felt generally miserable, lost her appetite and had a little pain in the right upper chest, anteriorly, although Doctor Cushing could find no pleuritic signs to correspond. There was also slight cyanosis, and some increase of sputum. The anterior operation was postponed on this account for nearly two weeks, by which time she had largely recovered, although still not so well as before the vaccine. Pulse remained fast. Doctor Cushing thought this partly mechanical from pericardial adhesions drawing the heart up to the left axilla, and suggested that liberation of the pleura might relieve this interference with the heart action. X-rays showed some breaking down in the small area of consolidation at the bottom of the sound side, otherwise there was no change on that side. After considerable hesitation the anterior operation was decided upon. It was proposed to her, indeed, that she should go back to California and wait for six months or a year; to which she answered that if she went home she would never come back. On December 20th apicolysis was done. Muscle flaps were formed of the greater and lesser pectorals. The 2nd, 3rd and 4th ribs were resected in lengths of from 1 to 2½ inches. The base of the heart and the large vessels occupied the inner half of the space exposed, the lung being contracted towards the axilla. A thorough liberation of the lung was done anteriorly over the apex down to the 2nd rib behind and round the axilla till one met dense adhesions under the area exposed at the second posterior operation. These adhesions were too dense to separate without danger. The muscle flaps filled nicely the cavity created. The wound was closed without drainage.

This operation was badly borne, especially by the heart. The pulse immediately ran up to 140, respirations to 32, and they remained at about this level for two days, the temperature, however, keeping about normal. Under digitalis and heroin the heart steadied down, the pulse dropping twenty points. There appeared paradoxical respiration; and obviously some strain was being put on the other lung. The sputum was thick and the cough was unproductive. She vomited also frequently for thirty-six hours. It looked, however, at the end of the second day as if she were going to rally quite well, but at this point the temperature rose and on the third day reached 101.3, while respirations went up to 36 and pulse to 132. Some cyanosis appeared and Doctor Cushing found an area of impaired note over the right lower lobe behind with numerous crepitant râles, but no definite blowing breathing. This went on during the 4th and 5th days into an obvious broncho-pneumonia with infective bronchitis. She became more cyanosed, and on the 6th day she died from a filling up of the sound lung, and gradual exhaustion of the heart. Death was obviously due chiefly to an acute infective process in the sound lung, which was probably brought on by the mechanical strain put upon it by the operation, but was also due, in part at least and primarily, to the mechanical interference over the heart area and the loss of a certain amount of support from the side of the chest wall to which it was adherent, and to the interference with the respiratory movements of the diseased side. If she had not had, to start with, a mild infective condition in the bronchi of the sound side, she would probably have recovered, inasmuch as she had rallied quite well on the second day.

The lesson, therefore, is that we erred in taking a chance with a so-called "relatively healthy" lung which proved to be not healthy enough. It emphasizes the importance of demanding that the other lung shall be practically sound before one does an extensive thoracoplasty, or at any rate an apicolysis. In this case I

## UNILATERAL PULMONARY TUBERCULOSIS

ought to have refused to do the final stage of apicolysis, and should have insisted that she return home and wait for six months or a year in order to get stabilized again, recover from the ill effect of the autogenous vaccine and from any recent activity (suspected if not proved) in the sound lung, and allow the full development of whatever benefit the posterior operation might bring about. I believe that after that length of time fibrosis would have been materially advanced, and the right side might have become more certainly quiescent. And even if these hopes had not been realized, she would not have been any worse than before the operation.

CASE II.—Dr. W. H., aged fifty-five. Referred by Doctor Parfitt, of Gravenhurst. Admitted to the hospital, June 8, 1920. His disease was first diagnosed in 1910. After a year in Switzerland he continued his practice for three years, though with constant cough and expectoration. In 1916 he went to Gravenhurst and improved a great deal. Since then the course of his disease has been marked by a series of ups and downs, with frequent bouts of fever, and with gradual deterioration. Upon admission he was found to be in poor general condition. He was pale, and emaciated; his cough was very troublesome, his sputum was purulent, and measured from 4 to 6 ounces in a day. His whole left lung was diseased; there was a large cavity in the upper lobe, advanced fibrosis, and much retraction of the chest. The right lung was healthy, save for a slight arrested lesion at the apex. On account of his age and his poor condition I hesitated to operate, but, being urged by Doctor Parfitt, I decided to do so. On June 11, 1920, I removed from the 10th to the 7th ribs; and on July 7th the 6th to the 2nd. He made a slow convalescence, but cough and sputum steadily decreased, fever disappeared, and his pulse came down. About six months later I had from him an enthusiastic letter. He had improved steadily and had gained fifteen pounds in weight. His sputum was down to one ounce in the 24 hours; his pulse and temperature were steadily normal. Seventeen months after operation I heard from him again. His cough was practically gone; his sputum was less than half an ounce, and was constantly free from bacilli; he had no fever and had gained 26 pounds, and felt altogether well.

I need hardly relate in this place the histories of other cases. The two just given will suffice to teach the lesson, both of caution and of hope.

May I in conclusion give expression to the confidence which I feel that the profession possesses in this operation a valuable therapeutic means for the improvement and even the "cure" of a not inconsiderable number of the tuberculous who are not otherwise to be saved? I look forward confidently to a day not far distant when the State will fulfil its duty of caring for all its indigent tuberculous; and when in close connection with every sanatorium and in every city there will be found at least one surgeon who shall have made himself competent to operate upon such patients with the full measure of safety possible under the circumstances.

*Addendum, May 22, 1923.*—Since writing the above the number of cases has increased to 31. Of the last 16, one died some six weeks after operation of an aspiration pneumonia on the sound side. The results otherwise have been about the same as those above reported.

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## TUBERCULOSIS OF THE BREAST

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WHEN we consider the enormous number of people affected with tuberculosis and compare this to the number of cases of tuberculosis of the breast reported in the literature we are at once struck with the rarity of the latter condition. There have been reported up to the present time about two hundred cases comprising about 1 per cent. of all breast diseases.

The first account of tuberculosis of the breast is due to Sir Astley Cooper,<sup>1</sup> who in 1829 described the macroscopic features of "scrofulous swelling of the bosom." Virchow, however, included the breast in the organs not affected by the disease. Dubar<sup>2</sup> was able in 1881 to prove microscopically that tuberculosis attacked the breast and that the disease here was similar to the condition elsewhere in the body, and in 1883 Ohnacker<sup>3</sup> succeeded in making a positive inoculation from the pus of a mammary abscess. In 1904 Auspach<sup>4</sup> reviewed the literature and compiled 77 cases reported up to that time, of which 42 were primary in the breast. In 1914 Deaver<sup>5</sup> reviewed the literature and compiled 74 cases reported between 1904 and 1914, including 5 personally observed, of which 45 were of the primary and 29 of the secondary type. Accepting only those in which tuberculosis was proven by microscopic section, only about 150 cases have been reported since 1881. Since 1914 Miles<sup>6</sup> has reported six cases, of which three were primary and three secondary. Gatewood<sup>7</sup> in 1916 reported 5 cases, of which three were primary and one secondary. Durante and McCarty<sup>8</sup> reported ten cases observed at the Mayo Clinic, of which three were primary. Hamilton<sup>9</sup> in 1920 reported a case of primary infection. To these we add seven observed at the Peter Bent Brigham Hospital between 1913 and 1922.

According to the usual grouping we have classified as primary tuberculosis of the breast, those in which no focus of the disease could be discovered elsewhere in the body, and as secondary those harboring the disease in some other part. Under such a classification five of our cases were primary and two secondary infection. However, to assume that tuberculosis is primary in the breast presupposes that the organism gained entrance through the skin or nipple or else through the blood stream without causing disease at the point of entry. That the tubercle bacillus can enter the body through the unbroken skin or pass through uninjured mucous membrane has been conclusively proven, but it is more than likely that most cases of so-called primary infection are really secondary to some unrecognized focus. For this reason, Gatewood,<sup>7</sup> suggests the terms "protopathic" and "deuteropathic" for the true primary infection and the type secondary to an unrecognized focus.

In the secondary variety, the primary focus is most usually located in the axillary lymph-nodes, the adjacent ribs, pleura, or lung. Infection from a

TABLE I.  
Summary of Cases, P.B.B.H., 1913-1922

Case number	Surgical number	Age	Type	Family history	Past history of tbc.	Nursing of children	Trauma at time of onset	Side	Location quadrant	Sinus formation	Enlarged axillary glands	Other foci	Wassermann	Tubercle bacilli	Microscopic diagnosis	Treatment	Result
I	4983	36	Primary	Neg.	Neg.	No	None	R.	Upper inner	Present	Enlarged	None found	Neg.	Not found	Tbc.	Amputated breast. No axilla	Healed readily. Well with no recurrence, five years after operation.
II	5002	21	Primary	Neg.	Neg.	No	Def. history of blow	L.	Lower outer	Present	Not enlarged	None found	Neg.	Not found	Tbc.	Amputated breast	Primary healing. Well six years after operation.
III	7103	26	Primary	Neg.	Neg.	Yes	None	R.	Lower	Not present	Not enlarged	None found	Not done	Not found	Tbc.	Partial amputated breast	Good healing. Well two years after operation.
IV	10737	24	Secondary	Pos.	Neg.	No	None	L.	Lower inner	Not present	Enlarged	Rib	Not done	Not found	Tbc.	Excision tract and rib	Healed. Well for three years and no further breast condition. Tuberculous gland of neck excised five years later.
V	10273	23	Primary	Neg.	Neg.	Yes	None	L.	Lower inner	Present	Enlarged	Not found	Neg.	Not found	Tbc.	Amputation of breast. Dissection of axilla	Primary healing. Baby born one year after operation. Well with no recurrence eighteen months after operation.
VI	13988	37	Primary	Neg.	Neg.	At time of onset	None	L.	Upper outer	Present	Not enlarged	None found	Neg.	Found	Tbc.	Partial amputation	Good healing. Well three months after operation.
VII	17831	34	Secondary	Neg.	Neg.	Yes	None	R.	Central	Present	Not enlarged	Lung	Neg.	Not found	Tbc.	Amputation of breast	Primary healing. Well five months after operation.

## TUBERCULOSIS OF THE BREAST

contiguous focus, as the rib or sternum, by direct extension is not uncommon as in Case IV of our series. In the presence of axillary lymph-node involvement it is often impossible to tell whether the breast is primarily or secondarily involved. Illustrative of this point is the interesting case of Duvergey<sup>10</sup> quoted by Deaver.<sup>5</sup> The patient, while washing the linen of tuberculous patients, abraded a finger of her left hand. The wound suppurated for two weeks and then healed completely. Eight months later she noticed a swelling in the left axilla, which was incised and from which pus was evacuated. The wound did not heal and three months later a painful lump appeared in the left breast. This was drained and from time to time other



FIG. 1.—Surgical No. 17831. Tuberculosis of the breast, showing retraction of the skin and nipple with multiple discharging sinuses.

sinuses developed in the breast. The lungs eventually became involved and tubercle bacilli were found in the discharge from the sinuses. Here the evidence strongly points to retrograde lymph-vascular infection, but in our series, Case VI has been classed as primary although the axillary lymph-nodes may have been the primary seat of infection. With the exception of this case, only those cases of our series were classed as primary in which there was no other recognizable or even suspected focus, either by history, physical examination, or röntgenography. In all the diagnosis was definitely established by microscopic examination of the breast tissue and in addition the tubercle bacillus was demonstrated in the discharge from the sinus in Case VI.

*Predisposing Causes. Sex.*—It is essentially a disease of the female breast, only eleven male cases being reported. All our cases occurred in women.



FIG. 2.—Cut section of breast, showing numerous tubercles. Note the two abscess cavities and the sinus tract.



## TUBERCULOSIS OF THE BREAST

*Age.*—Eighty per cent. of the primary variety and 70 per cent. of the secondary collected by Deaver<sup>5</sup> occurred between the ages of twenty and fifty proving the correctness of von Eberts' statement "that the period of reproductive activity embraces the vast majority of cases." The youngest in our series was twenty-three and the oldest thirty-seven. Five of our patients were parous and had nursed children; one of them was lactating at the time of onset of symptoms.

*Heredity.*—A family history of tuberculosis was noted in only one of our cases and probably plays no more important rôle in tuberculosis of the breast than in the disease elsewhere.

*Trauma.*—The part played by trauma is that observed in surgical tuber-

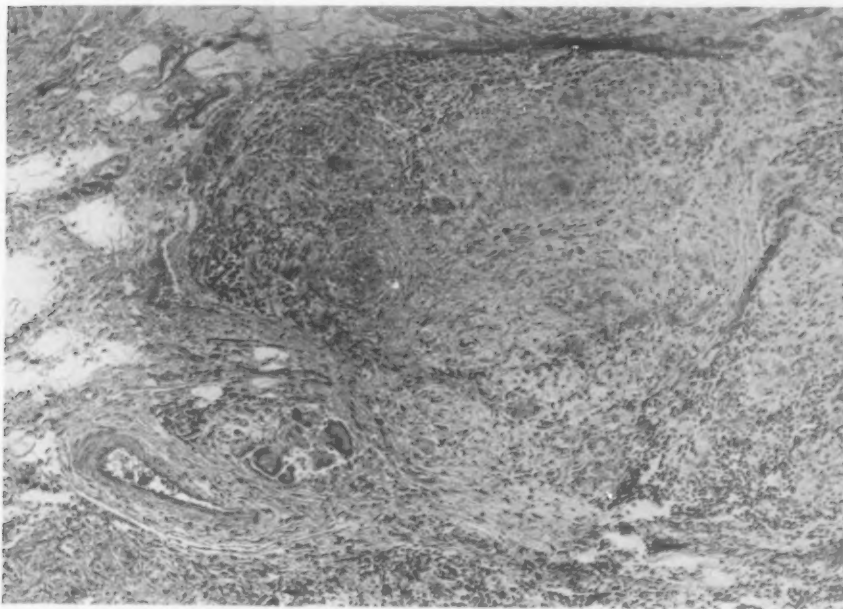


FIG. 3.—Photomicrograph showing round cell infiltration and the presence of giant cells.

culosis elsewhere, in that a latent focus may be activated by the injury. Excepting the trauma coincident with nursing, only one of our cases gave a definite history of injury (Case II). In one of Scott's<sup>11</sup> cases, a tuberculous condition followed infection with a needle. Hamilton's<sup>9</sup> case was preceded by definite injury.

*Symptoms and Course.*—The most frequent initial symptom is a painless lump. This was observed in 65 per cent. of the primary and in 75 per cent. of the secondary cases collected by Deaver.<sup>5</sup> In five instances this was the first thing noticed by our patients. Pain, practically always present in the later stages, is comparatively rare at the onset, being present in only 9 per cent. of the primary type and in 7 per cent. of the secondary cases of Deaver's<sup>5</sup> series. In two of our cases it was the first thing noticed; in one, following trauma.

With rare exceptions mammary tuberculosis tends to suppurate early. After a few months, the lump softens, the adherent skin becomes red and thin, and finally, if not incised, ruptures spontaneously with the formation of a persistent sinus (Fig. 1), and perhaps at the same time or successively at various points other tracts develop until the breast is undermined and riddled with discharging sinuses, which run a chronic course with little tendency to heal.

At the same time the axillary glands increase rapidly in size and often present all the characteristics of tuberculous adenitis, but rarely suppurate.

We would emphasize as characteristic of this lesion the rapidity of growth of the abscess, the tendency to the formation of multiple fistulæ, and the early involvement of the axillary lymph-nodes.

Adherence of the skin and retraction of the nipple observed in a majority of reported cases were noticed four times in our series.

*Gross Pathology.*—Tuberculosis is almost invariably limited to one side, but simultaneous invasion of both breasts was noted by Albertin,<sup>12</sup> and successive invasion was observed in one case by Walther.<sup>13</sup> It is usually limited to one quadrant.

The process is fundamentally the same as in any organ, except for variations due to the structural peculiarities of the breast. With few exceptions all cases are embraced in three main types; (a) disseminated, (b) confluent, and (c) sclerosing.

Dubar<sup>2</sup> described a *forme disséminée*, and a *forme confluyente*, but it is probable that these are but two successive stages in the evolution of the same process. In the beginning, a segment of the breast may be studded with small irregular lumps, of firm consistency, with a yellow centre and a gray-blue periphery. These nodules remain distinct, or later join in forming a single nodular mass, undergoing caseation at the centre. Sometimes suppuration and fistula formation proceeds from small independent foci, or less often a large single "cold abscess" is formed (Fig. 2). Scott<sup>11</sup> described a type of "sclerosing tuberculous mastitis" characterized by diffuse sclerosis, in which the process either overlies deep abscesses or is deep to them, or more rarely where the whole lesion is essentially fibrous. In addition the breast may be involved as a part of a generalized miliary tuberculosis.

Prognosis depends largely upon the degree of involvement of other organs. Primary tuberculosis is practically always curable provided early and radical operation is carried out. With one exception all in Deaver's<sup>5</sup> series left the hospital apparently cured. All our primary cases are well from one to five years after leaving the hospital. One patient with secondary infection (Case IV) has had no recurrence in the breast but reentered the hospital after five years with suppurating tuberculous glands of the neck.

Treatment should be operative; amputation of the breast together with dissection of the axillary if the lymph glands are involved. Surgical treat-

## TUBERCULOSIS OF THE BREAST

ment of tuberculosis is not followed with such uniform success in any other part of the body.

*Conclusions.*—I. Tuberculosis of the breast is a comparatively rare disease as compared with tuberculosis elsewhere in the body.

II. Insofar as can be determined it may exist as a primary infection.

III. A breast abscess, with a tendency to the early formation of multiple fistulae and with involvement of the axillary lymph-nodes, should make one suspicious of tuberculous infection.

IV. Treatment is operative and prognosis is good in primarily infected breasts, provided operation is early and radical.

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## TUMORS OF THE BREAST—INNOCENT AND MALIGNANT

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TEN years ago the writer presented a paper before the Canadian Medical Association on the subject of breast tumors. At that time 323 cases were reported for study. In the present paper 125 cases from one's private records have been added, making a total of 448 cases for the purpose of our present investigation.

In my former paper it was urged that the chief necessity in the study of tumors in the breast was to recognize malignancy early. To-day, that statement is made with still greater emphasis. In the last ten years, many suggestions have been made in the attempt to wrestle more effectively with this treacherous and terribly fatal disease. These suggestions have included attempts by improved technic to perform a more radical operation, and the more skilful use of radium and X-ray therapy. In spite of all efforts we are compelled to admit that we have no certain means of eradicating breast cancer once there is a primary growth in the breast with secondary metastasis in the adjoining lymph-nodes. To-day the greatest safeguard to the public is the early recognition and the early and thorough removal of the cancer growth. No radical measures in treatment can compete in effectiveness with the early diagnosis and immediate removal of the disease by operation.

In the past decade we believe the greatest progress which has been made in the treatment of cancer of the breast is found in the better education of the public and indeed of the profession regarding cancer. In former days it was not very uncommon to find doctors waiting for certain signs of malignancy before advising their patients to seek surgical intervention. Those days have gone by and we find the profession, as a unit, alert to recognize the earliest possible signs of malignancy and to secure immediate measures for radical relief. In doubtful cases there is no fatal temporizing but the diagnosis is cleared up without any delay by the surgeon and the pathologist. Then again the laity are better informed. They have come to realize that cancer in its early manifestations is a curable disease. We commend the work of the American Society for the Control of Cancer, which is accomplishing such excellent results. The institution of an annual "cancer week" when, in an intensive fashion, the public are instructed, is to be commended as a most effective measure for controlling the ravages of this disease.

Summary of cases under revision:



## TUMORS OF THE BREAST

The number of cases previously reported and analyzed ..... 323  
 To which for the purpose of this paper are added an additional number  
 from my private cases ..... 125

Making a total at present under investigation ..... 448

Classified as in previous paper as follows:—

<i>Malignant Growths.</i>	Previously reported	New cases
Carcinoma .....	212	74 = 286
Sarcoma .....	4	1 = 5
		— 291
<i>Benign Growths.</i>		
Fibro-adenoma .....	75	19 = 94
Chronic mastitis .....	32	28 = 60
Lipoma .....		1 = 1
Tuberculosis .....		2 = 2
		— 157
Total.....		448

### STATISTICS OF THE ENTIRE GROUP OF CASES

*Malignant Cases. Age.*—In malignant cases the oldest patient in previous series operated upon was 78 years of age and the youngest 28. In my recent series the oldest patient operated upon was 80 and the youngest 31.

The average age in previous cases was 49.2 years and in the recent cases 49.6 years.

Taken in decades the following comparative study was made.

	Old series.	New series.	Total cases.
30 and under .....	3.4%	0%	2.4%
31 to 40 inclusive .....	17.5%	24.6%	21.0%
41 to 50 inclusive .....	40.0%	32.8%	36.4%
51 to 60 inclusive .....	19.0%	19.1%	19.0%
61 to 70 inclusive .....	14.0%	16.4%	15.2%
70 and over .....	5.6%	5.0%	5.3%

*Benign Cases.*—In benign cases the oldest patient operated upon in my previous series was 61 years of age and the youngest was aged 19. In my more recent series the oldest patient operated upon was 58 and the youngest 11 years of age.

The average age in previous series was 37 years and in my recent series 37.2 years.

Taken in decades the following comparative table was constructed:

	Old series.	New series.	Total cases.
20 and under .....	3.0%	6.0%	3%
21 to 30 inclusive .....	23. %	14. %	18.5%
31 to 40 inclusive .....	38.5%	46. %	42.3%
41 to 50 inclusive .....	27.7%	26. %	26.9%
51 to 60 inclusive .....	6. %	8. %	7. %
over 60 .....	5.6%	0. %	2.3%

Tumors of the breast may be inflammatory in origin or they may be new growths. Mastitis is exceedingly common, both acute and chronic, with or without suppuration. Tuberculosis, syphilis and actinomycosis constitute the rarer forms of specific breast infection resulting in tumor formation. By

far the most common malignant growth in the breast is cancer, while sarcoma occurs as a very rare event. Of the benign growths we have adenomata or fibro-adenomata, and much more rarely such tumors as angioma, myxoma and lipoma. The tendency to cyst formation in tumors of the breast is very marked, and is found both in inflammatory conditions and in new growth. The relationship of cysts and papillomata in the breast to the subsequent development of new growths has been recently studied by Sir George Cheatele. He has shown the relationship which exists between cystic and epithelial changes, on the one hand, and the development of a new growth of a simple or malignant type on the other. The technic which Cheatele employed was to make whole sections of the entire breast with a very large microtome and to study the relationship of cyst formation to the gland ducts and the gland acini along with the epithelial hyperplasia accompanying the cyst formation. He showed very conclusively that the cystic state acted as a predisposing and determining cause in the initiation and growth of tumors both simple and malignant. In a paper published by Bloodgood a few months ago, we have his views on benign lesions of the female breast for which operation, in his opinion, is not indicated. He reports 267 cases of this nature which have come under his observation. With many of his conclusions we agree, for example there could be no difference of opinion as to his good judgment in refusing to operate on 50 women who had pain and 22 cases with painful scar, in both series without tumor. We have no doubt in our mind that circumstances might justify him in refusing to operate on 17 cases of tumors of the axilla including aberrant breast tissue, lipoma, lymph-glands, tumors of the sebaceous and sweat-glands; nor again do we question his judgment in refusing to operate on 15 cases of hypertrophy of the breast. In fact, in the whole series we are in entire agreement with the exception of one most important group. We refer to 64 cases of "definite and indefinite, single and multiple tumors in one or both breasts in women over twenty-five years of age." Doctor Bloodgood gives his reasons why he refused to operate in these cases. The 64 cases represent, it is true, but a small number of the total cases treated, this is obvious, for example, when he states that "in almost 3000 cases of breast lesions" there were "but five cases in which . . . a single definite tumor in one breast in a woman at the cancer age" existed and in which operation was refused. Nevertheless, our experience, though much less extensive than Doctor Bloodgood's, affords ample evidence that the teaching implied in his communication is to be questioned. The doctrine is in our humble opinion unsound. We cannot analyze the details of his cases to the extent we would wish in this present paper, but we consider he is too dogmatic in his assertions regarding the harmless nature of dilated ducts and simple cysts. Cheatele's work, already referred to, has demonstrated a direct relationship between cysts and malignancy. Again while, in Bloodgood's words, "multiplicity, of multiple tumors is suggestive of benignity," these multiple tumors at the cancer age must invariably be looked upon with grave suspicion. One single example will suffice from my series.

## TUMORS OF THE BREAST

A married woman thirty-three years of age: Both breasts presented a firmly nodular diffuse condition, the axillary glands were palpable on both sides: Both breasts and the axillary glands were removed at one operation; the right breast tissue when examined under the microscope showed medullary carcinoma with metastases in the lymph-glands, the left breast showed no evidence of malignancy in either breast or glands. Twenty-nine months after operation, she presents herself with metastases in the supra-clavicular glands of the right side.

Such a case to my mind proves a very definite relationship between chronic inflammatory conditions in the breast (chronic mastitis) and malignancy: the latter is often the precursor of carcinoma. This is illustrated in many of my cases, thus, for example, a woman of thirty-three who was operated upon for cancer of the right breast, gave a history of a number of hard lumps which had existed in the breast for six or seven years. This patient died subsequently from recurrence.

Then again, in contending that simple cysts in women under twenty-five are not dangerous, we would refer to the following case:

A single woman aged twenty-three, had a lump in the right breast to the outer side of the nipple, along with a more or less diffuse nodular thickening, no glands were palpable in the axilla. The breast was removed. The section under the microscope showed dilated ducts filled with cells; one can trace all stages in a papillomatous development of these cells, at no point however did the cell hyperplasia burst beyond the basement membrane, nor were there any mitotic figures. The pathologist reported it as a "precancerous condition." Can anyone question the wisdom of removing such a breast?

We must therefore protest against the teaching of Bloodgood and favor rather that implied in the aphorism of his colleague Doctor Finney, when he said, "Any lump in any woman's breast is better out than in."

In my recent series of 125 cases there were 15 requiring removal of both breasts by operation. These were as follows:

Cancer in both breasts .....	11 cases
Cancer in one breast, chronic cystic mastitis in other breast.....	2 cases
Chronic cystic mastitis in both breasts .....	2 cases
	—
Total .....	15 cases

Of the eleven cases with amputation of both breasts there was only one instance in which both breasts were removed at the same sitting for bilateral development of cancer. There was an interval in all other cases between the first operation and the occurrence of disease in the second breast demanding operation. The shortest interval was eight months and the longest six years and ten months. The following table indicates the facts in greater detail regarding the 11 cases of cancer in both breasts.

# ALEXANDER PRIMROSE

	Age at last operation	Interval between operations	Note on individual case.
No. 1	40	Both breasts at one sitting.	Right breast showed medullary type of cancer. Left breast was scirrhus in type. She died 14 months subsequently with metastasis in lungs
No. 2	35	8 months	She exhibited metastasis in spine 15 months after last operation.
No. 3	39	1 year	Died of recurrence 10 months after last operation.
No. 4	42	1 yr. 4 mos.	
No. 5	57	1 yr. 6 mos.	
No. 6	80	1 yr. 10 mos.	
No. 7	54	2 years	Both Paget's disease of the nipple.
No. 8	56	2 yrs. 1 mo.	
No. 9	43	2 yrs. 2 mos.	
No. 10	52	2 yrs. 8 mos.	
No. 11	45	2 yrs. 10 mos.	Five years after last operation developed bone metastasis in ribs and sternum.

Of the two cases showing benign conditions on one side and cancer on the other, the following is the summary :

No. 1	33	Both operations at one sitting	Right breast showed cancer with metastasis in lymph glands. Left breast no malignancy but chronic cystic mastitis. A year afterwards she returns with metastases in supra-clavicular glands of right side.
No. 2	39	8 years and 10 months	First breast removed showed chronic cystic mastitis. Second breast a scirrhus cancer.

Of the two cases of removal of both breasts for chronic mastitis; in one a woman of twenty-eight, both breasts were removed at one sitting. In the other, there was an interval of three years and four months.

In 74 cases of breast cancer therefore there were eleven in whom cancer developed in the opposite breast, *i.e.*, 15 per cent. Of these only one exhibited cancer synchronously in both breasts. The others occurred at varying intervals. In two of the 74 cases there was cancer in one breast and chronic cystic mastitis in the other.

Kilgore, in a careful analysis of a large series of cases, has deduced the formula that "The patient who has had one breast amputated for cancer is, if she survives five years, from three to four times more likely to develop

## TUMORS OF THE BREAST

cancer in the second breast than a normal woman of the same age in either of the breasts." He also believes that the majority behave as primary in the second breast and not as metastatic. He suggests also that his findings indicate the prophylactic removal of the second breast or redoubled care in observation of the second breast after operation on the first.

In a previous paper one analyzed in some detail the clinical manifestations of malignancy. It is not necessary to repeat these observations, but one must urge the necessity for a most thorough technic in the examination of the patient. Carefully studied, it is almost invariably possible to make a bedside diagnosis. It should not be necessary and may result in error to trust to the so-called "quick section" at the time of operation. I have elsewhere discussed this phase of the question at length.

I do not propose in this paper to discuss the technic of the operation for the radical removal of breast cancer. The principles involved in all effective methods involve the complete removal both of the primary growth and of the group of lymphatic glands receiving the efferent lymphatics of the breast. This will necessitate the removal of the costo-sternal portion of the pectoralis major and the pectoralis minor.

Treatment of cancer by X-ray and radium is attracting the attention of all practitioners of medicine. In all clinics, over the entire country, either one or the other or a combination of these radioactive agencies is being used either as a primary and sole method of treatment or as a treatment additional to the operation. We are convinced at the present time removal by operation holds out the best prospect of cure. In the clinic at Toronto, radium and X-ray are used as adjuncts to surgery and are employed in some instances prior to operation but chiefly, in intensive dosage, subsequent to the radical operation. Most if not all surgeons to-day hold the view that X-ray and radium should be utilized only as adjuncts to surgery. (Greenough, Bowing, etc.). We trust the employment of such agencies will prove a most potent factor in the cure of the disease.

Curiously enough we have observed that X-ray treatment will, in some instances at all events, relieve the pain in bone metastases, but as yet we are ignorant of the effect produced upon the progress of growth in such secondary deposits.

It would hardly seem necessary to emphasize the importance of a careful microscopic examination, of all tumor removed from the breast. Twenty years ago it was not uncommon to find incomplete operations without histological examination. To-day most practitioners are alive to their responsibility in that respect, and yet I find three cases out of seventy-four (4 per cent.) operated upon within recent years in which "a lump" had been removed without a pathological diagnosis and the patient comes back in a few months with advanced carcinoma! This surely is worthy of the most severe condemnation and does not reflect credit upon those who are guilty of such unpardonable neglect.

For the purpose of studying end results the writer has taken 76 consecutive



# ALEXANDER PRIMROSE

cases from his private records. These cases were all operated upon more than five years ago and are therefore available for study as to "five-year cures." The classification of Greenough has been adopted as follows:

## ENDS RESULTS—CARCINOMA OF THE BREAST

A. Total entries—carcinoma breast .....	76
B. Re-entries (entered more than once) .....	3
C. Recurrence from previous operation .....	6
D. Cases available for study of operability, mortality, etc. ....	67
E. Radical operation .....	51
F. Palliative operation .....	7
G. No operation .....	9
H. Operative deaths .....	0
I. Operative mortality ( $H \div E + F$ ) .....	0
J. Operability: Radical operations ( $E \div D$ ) .....	76 %
K. Operability: All operations ( $E + F \div D$ ) .....	86.5%
L. Inconclusive cases. Lack pathological examination .....	0
M. Inconclusive cases: Untraced .....	6
N. Inconclusive cases. Died within time limit without recurrence .	0
O. Cases available for end-result data .....	61
P. Radical operations .....	45
Q. Palliative operations .....	7
R. No operation .....	9
S. Number cases alive and well .....	19
T. Number of cases died without recurrence (over 5 years) ....	1
U. Number 5 year "cures" (all operations) .....	20
V. Number 5 year "cures" (radical operations) .....	20
W. Percentage of "cures" (all operations) ( $U \div P + Q$ ) .....	38.4%
X. Percentage of "cures" (radical operations) ( $V \div P$ ) .....	44.4%

## CLASSIFICATION OF END-RESULTS IN FORTY-FIVE RADICAL OPERATIONS

	Cases	Cures	Percentage of cures.
1. Early favorable (no glands involved) .....	11	10	91%
2. Favorable (glands slightly involved) .....	13	8	61%
3. Average cases (glands markedly involved) ....	21	2	9%

Greenough and Simmons report a five-year "cure" in 32 per cent. of 69 patients submitted to radical operation for primary cancer of the breast. Sistrunk, in an analysis of 218 cases, found that in 132 of these cases in whom the lymph-glands were involved only 19 per cent. were alive 5 to 8 years after operation, whereas of 86 patients operated upon before the glands were involved, 64 per cent. were alive 5 to 8 years afterwards.

Peck and White give the following end results in 69 cases of malignant tumor of the breast:

Alive and well more than 5 years .....	39%
Alive and well more than 5 years; cases with metastases .....	23%
Alive and well more than 5 years; cases without metastases ....	65%

Of recent years, attempts have been made to judge of end results, by fixing an arbitrary number of years of life after operation as indicating a cure.

## TUMORS OF THE BREAST

Most statisticians have worked upon a three to five-year basis. The information thus obtained is of undoubted value, but it is not absolutely conclusive, a fact well recognized by all. Even in extensive disease it is often remarkable how long a patient will survive a radical operation. Thus in a patient with the entire breast implicated and ulceration beginning, the radical operation was performed and she lived four years, dying eventually from recurrence. Again I have the remarkable history of a woman of sixty-three who had an operation for cancer of the right breast in November, 1916. This woman is still alive, over six years after operation; she has a recurrent mass in the axilla and secondary metastasis in nearly every bone of her skeleton. Her history will be described in greater detail later in our consideration of bone metastases.

Sampson Handley made an important contribution to this subject in his investigations regarding the secondary manifestations of breast cancer. His work, which is familiar to all those interested in the subject, was first presented in the Hunterian lectures before the Royal College of Surgeons in 1905; subsequently he published more extended observations in book form. He enunciated the view of continuous extension of growth along lymphatic channels and termed it "lymphatic permeation." This view was opposed to the "embolic" theory of the origin of secondary growths. His findings may be summarized as follows: He demonstrated continuous extension of cancer cells along lymphatic channels to the glands of the axilla and to the infra-clavicular and supra-clavicular groups. He also traced a continuous chain of invasion to the pleura, the lungs, and to the opposite breast. He similarly accounts for bone metastases in the humerus, the ribs and the spine. Perhaps his most interesting observation is the invasion of the lymph channels from the breast to the epigastrium and the navel, hence, by the lymphatics of the round and falciform ligaments cancer cells may bud off and become free in the peritoneal cavity and may lead to distant metastases in the intestine or in the ovary, the cancer cells being carried thither by the movements of the stomach and intestines or by gravity. The lymphatics of the diaphragm may be reached along the epigastric route and thus the rare implication of the retro-peritoneal lymph-glands and of the kidney is explained. Thus in the long-standing cases of breast cancer these distant metastases are brought about, according to Handley, by continuous invasion along lymphatic channels.

There is some confusion regarding the significance of palpable glands in the axilla in a case of breast tumor. We regard it as one of several local signs suggestive of carcinoma and yet induration and enlargement of axillary glands are by no means pathognomonic of malignancy. Ewing would have us believe that the lymph-nodes undergo a process of change antecedent to the actual development of secondary metastasis; he states that for months or weeks the soil is prepared in lymph-nodes draining a primary focus of carcinoma. He describes the more recent changes as consisting of moderate swelling of the gland, diffuse hyperplasia, catarrhal exfoliation of sinus endothelium, multiplication of follicles, not uncommonly at a later period the nodes become

atrophic and fibrous and may become extensively invaded by fat. The more recent changes he attributes to the absorption of toxic products from the tumor, autolytic and bacterial. This conception is not wholly in consistence with clinical observation. The changes in a lymph-gland antecedent to the production of a secondary growth are more likely to be synchronously developed with and dependent upon changes in the breast which are antecedent to the development of a carcinoma in the breast. We frequently find such inflammatory hyperplasia in the glands in cases of chronic mastitis and we believe such cases often develop cancer both primary and secondary. The following case illustrates my point. A woman aged thirty-three had a nodular diffuse involvement of both breasts with enlarged palpable glands in each axilla. Both breasts were removed with the axillary contents. The right breast gave a typical histological picture of medullary cancer with metastases in the axillary glands: the left breast was the seat of chronic mastitis, the glands showing inflammatory changes, but neither in the breast nor in the glands was there any evidence of malignancy.

The palpable axillary gland may, in some instances, give us the chief evidence of the true nature of the case. In a woman of forty-nine a radical operation was performed on a clinical diagnosis of breast cancer. The pathologist reported chronic mastitis without malignancy. Through an accidental circumstance the axillary glands were lost sight of and were not examined for some days subsequently: undoubted cancer was found in the glands; the breast was again carefully searched, and eventually a small focus of malignancy was found, surrounded by a large area of chronic inflammatory change. Among other things this illustrates the futility of trusting to a quick section in such a case.

On the other hand, carcinoma of the breast may in rare instances be responsible for distant metastases while the local lymph-glands escape. A woman, thirty-nine years of age, came to me with a metastatic growth in the spine. This woman had had the right breast removed three years previously for a tumor which histologically was considered cancer. The axillary lymph-glands had never been disturbed and never showed any signs of involvement. It is possible the late changes in the lymph-glands, described by Ewing and quoted above, may be responsible in some instances for failure of the metastatic processes to develop in the lymph-gland. The atrophic, fibrous and fatty changes in a gland may so interfere with its function as a filter that the cancer cells fail to take lodgement in the gland. These atrophic changes in the gland may have occurred as the result of inflammatory processes in the breast prior to the development of the primary cancer growth.

Clinically, when a diagnosis of a primary carcinoma has been made, we must always assume the involvement of lymph-glands even if there is no gross manifestation of the fact: our modern radical operation for breast cancer is devised to meet such an hypothesis.

If the primary growth is extensive and advanced the lymph-nodes rarely, if ever, escape, and these are noticeable in the gross. In fact, the absence of

## TUMORS OF THE BREAST

the gross involvement of lymph-glands at operation in a case exhibiting evidence of advanced and extensive malignant disease should lead us to doubt the accuracy of our diagnosis.

The implantation and dissemination of cancer during our operative procedures is a danger which must be guarded against in our operative technic. This danger exists, for example, in our operations for breast cancer. It is a very real danger in the manipulation of the cancerous breast prior to the operation or in the method of scrubbing and preparing the parts to secure an aseptic field. There is a strong argument here also against the employment of the "quick section" for diagnostic purposes at the time of operation. The writer has long held these views and has insisted upon the greatest gentleness in manipulating a cancerous breast both before and during operation. Dr. Leila Charlton Knox has recently published a paper on "The Relationship of Massage to Metastasis in Malignant Tumors." She carried out numerous experiments in mice; for example, in one series the animals were inoculated subcutaneously in the inguinal or axillary region with mouse carcinoma; the resulting tumor, when it reached the size of 5 mm. in diameter, was vigorously massaged for one minute on two consecutive days; the tumors were then excised and the animals killed twenty-seven days later. In a large percentage of the cases metastases were found in the lungs. In another series of experiments very gentle massage, carried out every day for a fortnight, with similar findings. Experiments of this nature are instructive and suggestive, the results obtained are quite in harmony with our knowledge of the dissemination of cancer in man.

*Bone Metastasis.*—One of the most interesting phenomena in the course of malignant disease is the occurrence of metastases in bone. The bone may be invaded by direct spread from the primary growth. In breast cancer, for example, we may have involvement of the ribs and sternum. According to Sampson Handley more distant bones may be reached (humerus, spine, etc.) by direct extension through lymphatic channels; one of his arguments in this connection is the immunity of the bones below the elbow and below the knee, such cases being too distant for lymphatic connection. On the other hand, he traces lymphatics to the deltoid insertion of the humerus, and to the great trochanter of the femur as the most likely points of entrance for these bones. Schmorl, on the other hand, considers the pathway to be by the blood stream.

Bone metastasis in cancer is much more common than was hitherto believed. Von Recklinghausen made a careful study of cancer growth in bone in 1891. Sir Henry Thompson, as early as 1854, reported a case of carcinoma of the prostate with metastasis in the spine. Schmorl of Dresden was one of the first to remark upon the very great frequency of its occurrence. According to this authority the metastatic growth may only be discovered by microscopic examination, but in the vast majority of cases it is distinguishable in the gross. Schmorl finds that of all cases of cancer coming to autopsy no less than 34 per cent. show metastases in bone. In late years the X-ray has

proved of great value in determining the diagnosis, and has demonstrated the frequency of its occurrence.

I have a number of cases in my series of which I may cite a few examples. There were two cases of mammary cancer in which metastases occurred in the cranial diploe. A comparatively common locality was the cancellous bone of the body of a vertebra.

As an example of metastasis in the spine I might mention the following case with a somewhat unusual history. A woman of thirty-nine had her right breast removed three years before she came under my observation. The nature of the trouble in the breast at that time was somewhat doubtful; it was supposed to be "chronic mastitis," but the report of the pathologist suggested probable malignancy. The axillary glands were not removed. A year and a half subsequently she complained of abdominal pain and pain in her back. As the result of the findings in an X-ray series after a barium meal her appendix was removed. She insisted, however, that her "back was broken" and in truth she was right. Three years after the removal of the breast a stereoscopic picture obtained by the X-ray showed an almost complete destruction of the body of the fourth lumbar vertebra, with less extensive involvement of the twelfth dorsal, and fifth lumbar and the upper part of the sacrum. It was a purely destructive process with no new bone formation and without any invasion of the intervertebral discs which remained intact. This patient, therefore, showed metastasis in the spine three years after the removal of a breast carcinoma and the remarkable fact remains that the axillary lymph-nodes were never involved and were not removed.

One of my patients exhibited multiple bone metastases at widely separated parts of the skeleton. A woman sixty-three years of age was operated upon for cancer of the breast with two subsequent operations, during the next three years, for recurrence in the axillary glands. Three years and a half after the first operation she was treated by an osteopath for "rheumatism" of the right hip. She had lost weight. Shortly after this she came to hospital when we discovered metastases in the upper part of each femur, the ribs, the humerus and the cranial diploe. This woman is still living, five and a half years after the breast was amputated and two years since the multiple secondary growths in the bone were discovered. She now has a large mass of recurrent growth in the axillary glands.

The course of events in the bone at the seat of a secondary carcinoma are of interest. Bone is destroyed at the seat of the growth and spontaneous fracture of a long bone may occur. In this event, under suitable conditions of rest and splinting, callus may be formed and union may occur. In other instances destruction of the entire thickness of a bone may involve a considerable portion of a shaft and union becomes impossible. The tumors are frequently multiple. A study of these cases would lead one to assume that in many cases a secondary growth of cancer in bone remains more or less dormant for long periods of time. The tumors do not, as a rule, grow to great size, they are confined within the bone, and do not tend to invade the



## TUMORS OF THE BREAST

soft structures beyond. In time, however, the surrounding tissues may be infiltrated and increased rapidity of growth ensues.

Metastatic tumors in bone may be present without being suspected by either the patient or her medical attendant; in many instances their existence has only been discovered accidentally. The complaint of pain in various parts of the skeleton, particularly in the spine in patients suffering from cancer, arouses suspicion, and an investigation by the X-ray should be undertaken. Treatment of these cases by the radiologist may possibly be of some service. It is impossible to make any definite statement in this regard, but certain cases would appear to be relieved of pain and to improve in general health under this treatment.

In the beginning of my paper I stated that by far the most important observation in studying the course of mammary carcinoma is regarding the duration of the disease at the time of operation. I complete my paper by a further reference to this subject. One can assert that the greatest advance in the past decade, in securing improved results and in saving life, lies in the fact that patients come earlier to the surgeon for treatment. That patients do come earlier is obvious in studying the following comparative statement of the average duration of disease at the time of operation in the old series prior to 1912 and to new series of cases under treatment in the last ten years.

AVERAGE DURATION OF DISEASE AT TIME OF OPERATION.

<i>Malignant Growths.</i>	Average Duration	Old series	New series.
		14.375 months.	12.75 months.
Those who came to operation under one year .....		54.5%	76.8%
Those who came to operation under six months .....		35.4%	53.6%
Those who came to operation under three months .....		19.0%	37.5%
Those who came to operation one month and under one month from initial symptoms .....		8.4%	27.0%

This result may in part, at all events, be attributed to the work of the American Society for the Control of Cancer. We fondly hope that further advances will be made in our knowledge of the nature of cancer, in our methods of diagnosis, and in improved treatment by operation or otherwise, but we feel assured that by far the most effective means of saving life and ameliorating suffering in breast cancer at the present time lies in the early diagnosis and prompt removal of the disease by radical means.

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## RANULA\*

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THERE is no commonly occurring instance of abnormal anatomy about which such vague theories are prevalent than ranula. The mucoid cysts that occur in and about the floor of the mouth can be roughly divided into two classes. There are a number of different kinds of relatively small cysts that appear to lie in, or just under the mucosa of the floor of the mouth or under the surface of the tongue which tend to protrude frankly into the mouth; they are in my observation comparatively rare, small in size and their complete excision is a simple matter. These have origin from various mucous or submucous glands and their chief surgical interest comes from the confusion that has arisen from not drawing a sharp distinction between these and the more common type of ranula which lies in the floor underneath the mucosa and submucous tissues and whose chief characteristic is what Doctor Thompson has called a burrowing quality. These may push the tip of the tongue and the mucosa of the floor upward and backward, but the greater bulk always lies buried deep in the tissues of the floor. The amount discernible from within the mouth is no indication of its real size and their complete removal may be very difficult or even surgically impracticable. The most commonly accepted hypothesis has been that such were obstruction cysts of the sublingual gland. This presupposes a unique reaction to the sublingual obstruction and such an explanation for submaxillary, submental and parafacial ranulae, seems still more unreasonable. I believe that the theory of obstruction of the submaxillary duct or dilation of a Fleishman's bursa can be dismissed without comment.

Doctor Thompson's hypothesis, that the deep ranula and related cysts originate from migrated portions of the cervical sinus, is sufficiently broad to explain all hitherto observed types. In his original communication† Doctor Thompson gives a very lucid explanation of the manner and cause of this migration. (Fig. 1.) I have come to accept his view, not so much because it may or may not be correct, but because it furnishes a logical basis for adequate surgery. When you attempt to attack a ranula from within the mouth and find that it extends up to the base of the skull as a parafacial cyst, as happened in two of our cases, or that a process extends an indefinite distance into the neck as happened in another, or find the ranula to have a submental extension, then thinking in terms of the sublingual gland

\* Read before the Southern Surgical Association, December 14, 1922.

† The Relationship Between Broncho-Genetic and Ranula Cysts, *ANNALS OF SURGERY*, vol. lxxii. p. 164, 1920.

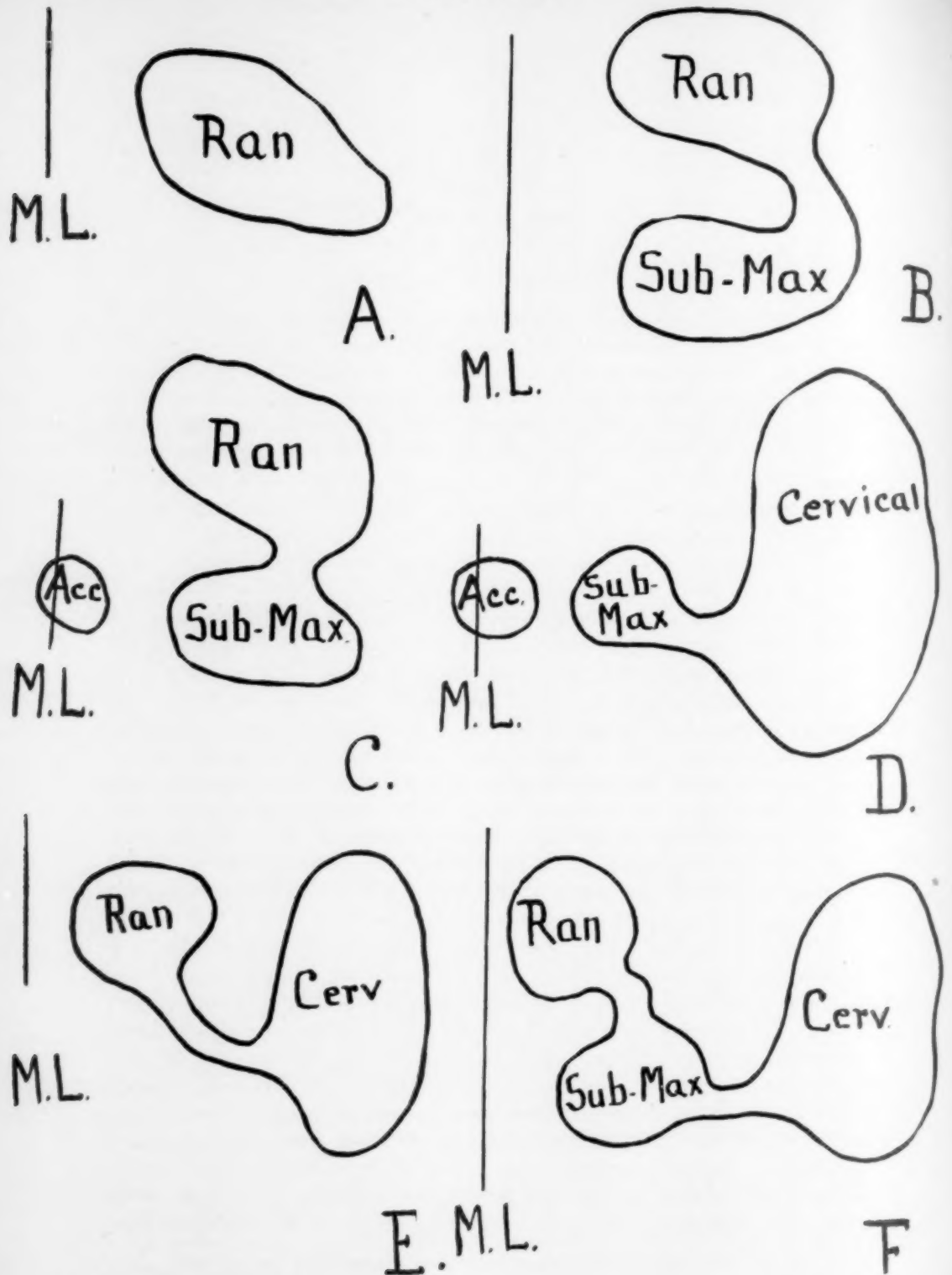


FIG. 1.—Doctor Thompson's original diagram, to illustrate the origin of the various types of deep ranula that he observed and which led him to conclude that these were all derived from the cervical sinus. A diagrammatic representation of the anatomical distribution of the cysts met with in the deep cervical, submaxillary and sublingual regions. A, represents a simple ranula. B, a ranula and submaxillary cyst communicating with one another by a neck. C, a ranula and submaxillary cyst communicating with each other; also a small isolated cyst in the submental region. D, shows a deep cervical cyst communicating with a submaxillary cyst; also an isolated submental cyst. E, shows a deep cervical cyst communicating with a ranula by a long narrow neck which traverses the submaxillary region. F, shows a deep cervical cyst communicating with a submaxillary cyst, which in turn opens into a ranula. The letters M. L. mean "middle line of the neck." For purposes of comparison all the cysts have been drawn on the left side of the body. (ANNALS OF SURGERY, vol. lxxii, p. 164, 1920.)

## RANULA

or any other intra-oral structure will not give the key to the correction of this surgical puzzle. If, however, you accept even tentatively, Thompson's cervical sinus hypothesis, you will then be better prepared to attack the cyst either from within the mouth or through a submaxillary incision or both.

### CASE REPORT

A woman thirty-four years of age who complained of a swelling which appeared on the left side of the floor of the mouth about two years ago. The swelling had been lanced repeatedly and "white of egg" material liberated, but for the last few months she has not noticed it. About two months ago the

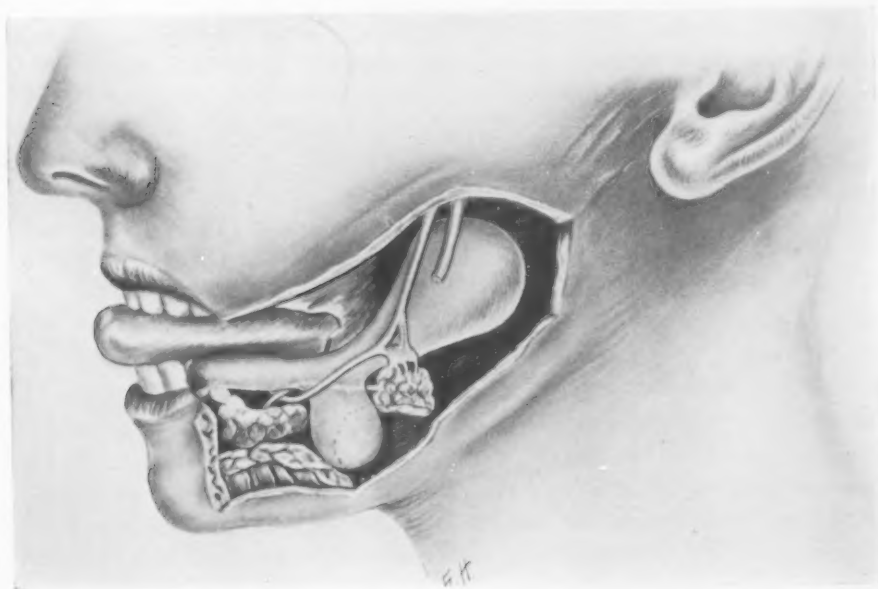


FIG. 2.—Is a semi-diagrammatic drawing of the relations found in the case here reported. It is from sketches made at the time of operation. The greater part of the submaxillary salivary gland lay superficial to the submaxillary extension of the cyst and was removed as a preliminary step in exposing the cyst. It will be noted that there is a constriction at the neck of the submaxillary cyst, bounded posteriorly by the "U" shaped bend of the gland as it turns forward with the first part of Wharton's duct. Normally this "U" bend embraces the posterior free border of the mylohyoid muscle, but here the muscle is pushed well forward by the cyst. Externally the neck is bounded by the submaxillary gland and the lingual nerve, and internally by Wharton's duct. Anteriorly it is sharply constricted above by the lingual nerve which has turned to run under Wharton's duct, and below this by the posterior border of the mylohyoid muscle. It is conceivable that part of the cyst might be pinched off to form the submental cyst sometimes found. The older theory was that submental ranula arose from an extension of the sublingual gland through the mylohyoid muscle. The parafacial part here shown extending upward deep to the lingual nerve did not have the attachment to the base of the skull that was observed in our other cases and it was dissected out intact. In this illustration the internal pterygoid muscle has been omitted. In removing the forward oral prolongation, it was found attached at one point to the upper surface of the sublingual salivary gland in the typical manner that has, I believe, been the chief basis for considering this type of ranula to be a cyst of the sublingual gland.

swelling appeared in the floor of the mouth on the right side, this had also been opened and had reappeared.

*Examination.*—On the left side in the anterior submaxillary region, she had a swelling about 2 cm. across which could be seen but hardly felt except when she swallowed. When she swallowed it became very tense and prominent and could be felt. Bidigital palpation of the floor of the mouth was negative anteriorly. Posteriorly in front of the fauces there was an indistinct fullness, but pressing on this point with one finger and on the tumor in the submaxillary region



with the other, a distinct sense of fluctuation could be obtained. On the right side she had a typical ranula extending from the midline and apparently lost posteriorly in the neighborhood of the first molar tooth.

*Operation.*—Under 2 per cent. novocain block of the lingual and inferior dental nerves of the left side and  $\frac{1}{2}$  per cent. infiltration of the submaxillary skin, an incision was made from just below the angle of the jaw to the middle of the hyoid bone. On drawing the submaxillary gland upward and backward a cyst appeared antero-mesial to the gland. It protruded from the floor of the mouth behind the posterior edge of the mylohyoid muscle which latter was pushed forward of its normal position. The submaxillary gland was removed excepting a little piece at the junction of the duct. The lingual nerve was adherent external (superficial) to the cyst with the branch to the submaxillary ganglion also crossing the cyst. The submaxillary branch was cut and the lingual nerve dissected from the cyst except possibly in one place where it was encapsulated in the wall of the cyst. The cyst was dissected free from the hyoglossus muscle, from the inner surface of the mylohyoid muscle almost to the midline, from the internal pterygoid muscle and from the wall of the pharynx (Fig. 2). A hole was made in the mucosa of the mouth near the first molar tooth. The mouth was opened and the cyst and Wharton's duct brought into the mouth through the opening in the mucosa. The mucosa of the floor was incised anterior to this opening as far forward as the midline and the cyst, Wharton's duct and the sublingual gland were removed in one mass. The wound was lightly packed and the skin approximated with horse hair. Free drainage was used. It was found on completion that the right-sided ranula had emptied itself, and it was not disturbed at this time.

In his original article Doctor Thompson called attention to the impracticability of removing the para-facial extension of the cyst when the latter is closely adherent to the base of the skull and the styloid process. In the Moulin's Treatise on Surgery (note Second American Edition, 1893) in the treatment of ranula, he notes that simple incision and cautery seldom cures, and to avoid the more difficult operation of the excision, recommends a triangular incision and suturing the triangular flap down into the bursa to make a permanent drainage fistula. This same plan, using a large quadrilateral flap from the mucosa of the cheek, can be used to establish permanent drainage from an irremovable part of the para-facial extension of the cyst.

## FACTORS OF SAFETY IN THYROID SURGERY\*

By WILLARD BARTLETT, M.D.

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ONE who studies the results of thyroid surgery with a view to lessening mortality and shortening morbidity, may quite well be impressed by the fact that certain fundamental considerations, rather than developments in technic, have pointed out the way toward improved results. Reasoning thus, in our clinic all patients are grouped according to the exceedingly simple classification of Plummer and Wilson under four headings. 1. Exophthalmic Goiter (Hyperplasia). 2. Toxic Thyroid Syndrome (Adenoma). 3. Simple Goiter (Colloid, Adenoma). 4. Malignant Thyroids. One cannot absolutely classify all patients according to the above, or any other rule, since the symptoms do not always conform to those laid down for any one group, but may at times overlap two or more of them. However, one gets farthest by at least attempting a definite selection of the larger group in which the individual seems to belong. Without going deeper into this phase of the subject, which has received extensive consideration at the hands of many authors, we will proceed to the clinical side of it and lay stress on three of its aspects which we have found of utmost value. They are: 1. Classification as to Operative Indications. 2. Multiple Stage Operation. 3. Coöperation of Internist.

The classification of operative indications may vary, and no doubt do with different operators. Doubtless there are other classifications equally as useful as our own, but one is prone to enthuse over the procedure which has served him best. There are five classes into which we divide all patients who are considered fit subjects for surgery. 1. Ligation of superior thyroid vessel group. 2. Unilateral resection of the male subject. 3. Unilateral resection on the female subject. 4. Bilateral resection with wound left open. 5. Bilateral resection with complete wound closure.

As is well known, the superior thyroid ligations are done upon exophthalmic goiter patients as a part of their preparation for the removal of thyroid tissue. Ligations are not performed in the presence of toxic adenoma, because they do no good, and are thought by Charles H. Mayo, to be harmful in many instances.

Unilateral resections on the male (or on the female) subjects differ only in as far as cosmetic considerations go. In the former, we get at half the gland through an oblique incision along the anterior border of the sternomastoid muscle, retract it, spread the ribbon muscles longitudinally, and thus secure a very easy and direct approach to the lobe, and especially to its important upper pole. In the female, we make the customary collar skin

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\* Read before the Southern Surgical Association, December, 1922.

incision only, then proceed as above outlined for the male subject. A man's collar will cover any sort of skin incision made for the removal of thyroid substance, while a woman must depend upon some sort of chain during the early period of her convalescence. Hence, the separate classification of the two sexes.

Class (4) deals with large non-toxic goiters, irrespective of pathological considerations. After both lobes have been in great part removed, the cavities are packed with rubber and left wide open to allow twenty-four hours shrinkage in the tissues which cover them. During the next twenty-four hours complete cessation of bleeding takes place, so that when the wounds are closed, there is no longer much likelihood of serum or other fluid escaping from the diminished cavity resulting from such treatment.

Class (5) refers to rather small non-toxic goiters, the removal of which is invariably followed by complete closure, because if bleeding be perfectly controlled, there is no reason for leaving a drain behind. It may be stated in passing that we never use a drain as the term is commonly applied. We either pack the wound wide open or close it completely in every instance. Wound closure with us is an exceedingly simple procedure, since we no longer make extensive skin flaps, nor divide ribbon muscles transversely.

In regard to a multiple stage operation or the graduated approach to the complete removal of thyroid tissue, it may be stated that we have subjected one patient at least to as many as seven operative attacks before the ideal had been accomplished. Thus we ligated the right superior thyroid group, five days later we ligated the left superior thyroid group, twelve weeks later we cut flaps and left a pack exposing the right lobe, two days later the right lobe was removed, two days later the skin was closed, seven months later the left lobe was removed, two days later this skin wound was closed.

Of course, we have frequently ligated both superior thyroids at one sitting and removed both lobes at another, hence it will be seen that the graduated approach with us has meant two, three, four, or even more operative stages up to the number of seven, which is admitted to be the practicable limit. It will be stated, however, that in this last instance, we seemed at each attempt to go as far as the patient's endurance would permit.

The coöperation of the internist is considered most essential. With us, this matter is carried to the extent of allowing him the last word in deciding, not only what patients shall be operated upon, but he goes so far as to select the date of operation. We believe in this way, and in this way alone, that we can successfully do justice to the many considerations which in the past have led to an unwise choice of time for operation. We believe that an internist, who is especially trained for this work, will be guided in his choice of a subject for operation by five major fields for study, in addition to a large number of minor ones, namely The: 1. Myocardium. 2. Kidney function. 3. Metabolic rate (relative). 4. The patient's weight (relative). 5. The patient's self-control. These five considerations are so well known and so

## FACTORS OF SAFETY IN THYROID SURGERY

self-evident that most of them need hardly more than passing mention here, still, one may with propriety, add that the myocardium seems to us to play the leading rôle in the selection of a toxic surgical patient. The kidney function is determined by the ordinary methods of urinalysis, coupled with P. S. P. and N. P. N. in the ordinary run of cases. The metabolic rate is not a determining factor, but is merely taken into consideration with all of the clinical elements which go to make up the resumé. The patient's weight is very important. We feel that it is always a good sign when a patient is gaining weight, provided only that this be not due to an accumulation of fluid in the tissues. The patient's self-control is also of vast importance, especially since most of the operations on toxic patients are done without a deep general anaesthesia. The post-operative self-control of the patient should insure the minimum of restlessness as the resources of a toxic heart are thus only to be conserved. Here the matter of the patient's self-control becomes of vital importance in many instances.

Very little has been written, purposely, about the operative technic, since, as was stated in the beginning, we believe that our improved results have, in recent years, been largely due to a rigid observation of the various classifications which have been briefly stated. Still, there are technical considerations of so much value that it would perhaps be unwise to conclude without at least according them whatever prominence they may seem to deserve. They are: 1. Anaesthesia (three components). 2. Where operate? 3. Open or closed wound.

We are in our clinic strictly inclined toward local anaesthesia in our operations upon all types of goiters. This is said without minimizing in any way the value of general anaesthesia in certain uncontrollable patients. We believe, even when we stress novocain infiltration, that still, a local anaesthesia is made up of three components of which the infiltration is only one, the other two being some sort of a drug preparation (morphine, heroin, veronal, etc.) and the nitrous oxide oxygen combination, which Crile uses as a mask for infiltration. We do not employ this last as a routine, but never refuse it to a sufferer who asks for it and certainly do not spare it when we feel that we are safeguarding the patient's well being.

As to where to operate, it seems to us that the operating room offers better light and more conveniences than can be obtained elsewhere in the hospital for those individuals whose nervous systems are not unduly influenced by these unusual surroundings. This class can be greatly enlarged by the free use of preliminary drugs, but we often do a ligation in a patient's bed, and indeed during our hot summer months in St. Louis we very much like to do the thyroidectomy, as well as the ligation, on screened, well-lighted, breezy open porches. It is for the reason that a toxic patient with a high metabolic rate will remain surprisingly quiet if she gets all of the oxygen she needs, as is rarely the case indoors, especially in a small crowded room.

Whether to leave open or to close the wound, has been discussed in pass-

ing, but we will refer to it again in connection with the highly toxic goiter. It seems to us that every toxic patient should have the thyroidectomy wound left open in order that there may be no possibility of the damming back of any of the fluids during the course of the operation. This was proven in our earlier work by the removal of sutures, resulting in the rapid clearing up of a dangerous post-operative thyrotoxic condition, as serum escaped from what had been a closed wound. The operation is in addition, considerably shortened by leaving the wound open, while the patient is only slightly disturbed twenty-four hours later when rubber packs are slipped out and three or four skin clips applied.

One may add in closing that the relative space here accorded technical considerations in comparison with that accorded the reasoning of a more fundamental nature, expresses pretty well our opinion of the relative values of these two components, which go together to make for better results in the surgical treatment of thyroid disease.



## PATHOLOGICAL FRACTURE OF THE NECK OF THE FEMUR, DUE TO THYROID METASTASIS

BY ISADORE ZADEK, M.D.

OF NEW YORK, N. Y.

*Case Report.*—Patient a man, aged fifty-six, family history, negative, past history, negative. In January, 1920, while running to catch a street car, the patient slipped on the ice and fell, striking his left hip on the pavement. He was picked up and carried off the street. Thirty minutes later he got up and went to work, although he limped and had pain in the hip. He continued working and on the third day, as pain and lameness continued, he called in the family doctor who said there was nothing wrong with him.

Two weeks later he called in another doctor who said he had a bruise only. A third doctor said he had a "cold in the nerves." For five weeks he received baking and massage three times a week at the dispensary of the Hospital for Joint Diseases. This treatment relieved him temporarily. In June, 1920, he went to Bellevue Hospital where an X-ray showed a rarefied area at the base of the neck of the femur. As the limb was wasting, it was thought a malignant tumor might be present. He was operated upon. An incision was made on the lateral aspect of the hip and a piece of tissue was removed. No tumor was found. Nothing else was done and in six weeks he went home. He got a special shoe which he has worn since. During the winter of 1921, he received baking and massage for six weeks at Beth Israel Hospital.

On examination April 2, 1921, by Dr. Royal Whitman the following note was made. "Walks with crutches—left limb practically helpless. Lifts it with hand. Shoe has one and a half inch elevation. Has considerable pain, especially at night. Unable to lie on affected side. Distance from the anterior superior spine to the internal malleolus on the right  $33\frac{3}{4}$  inches. Distance from the anterior superior spine to the internal malleolus on the left 32 inches. There is pain on motion. Marked limitation on attempted abduction and rotation. Presents large inguinal hernia on left side. Tumor size of testicle on right side. X-ray shows complete absorption head of femur and atrophy of neck. Base of neck appears to be in contact with head. Reconstruction operation."

Operation, April 4, 1921, by Doctor Zadek. Usual incision was made in the line of the thigh midway between the anterior superior spine of the ilium and the greater trochanter. Fascia lata was split in the line of the skin incision and exposure made between the tensor fascia femoris and the vastus externus. There were numerous moderately enlarged veins running in the direction of the external circumflex which were ligated. Capsule was opened in the direction of the neck. It was markedly thickened. Further exposure showed that the actual conditions were not as one would have expected from the X-rays. The chief line of fracture with displacement was intertrochanteric. Almost all of the greater trochanter was adherent to the head and neck fragment. Only the outer shell of the greater trochanter was connected with the shaft fragment. At the site of fracture there was a large cavity extending down the shaft for about 2 inches and extending probably 1 inch into the base of the neck and into the greater trochanter, the total size of which was about that of a large egg. The fracture was comminuted and one small fragment was removed. The greater trochanter was broken from the base of the neck in addition, but was not displaced and the lesser trochanter was likewise broken but not displaced. The bone cavity was

filled with what was, grossly, reddish, velvety, granulation tissue, which was quite friable. Underneath this granulation tissue the bone was apparently solid. The edges of the fragments were quite irregular and serrated. This tissue resembling granulation tissue was thoroughly removed with a curette and the shaft fragment forced upward into the cavity in the upper fragment. The muscles and fascia were closed with interrupted and continuous catgut sutures and the skin closed with continuous catgut. Plaster-of-Paris spica was applied extending from the nipple line to the toes with the hip in 20 degrees abduction, moderate outward rotation and full extension. Some of the tissue was saved for microscopical examination. It is interesting to note that there has been absolutely no attempt at repair of the fracture. The tumor does not pulsate.

"The piece of tissue sent to the pathological laboratory was reported by Dr. F. M. Jefferies as aberrant thyroid. Thyroid-adenoma." The thyroid acini contain colloid.

The wound subsequently became infected and on April 14, 1921, the original incision was closed with silkworm gut and another incision made posteriorly for better drainage. When the true nature of this tumor was known an attempt was made to discover the possible existence of other such tumors in the body. X-rays of all of the bones of the body including the skull, spine and pelvis were taken and they were all negative. X-rays of the lungs were likewise negative. As far as one can determine by physical examination patient's thyroid gland is normal.

Examination of the urine was negative save for a faint trace of albumen. There were no Bence-Jones bodies found on several examinations. X-rays taken after operation showed the alignment of the fragments good.

Patient was discharged from the hospital July 25, 1921. At this time patient could voluntarily flex the hip to 125 degrees. There was apparently good union at the site of fracture, the head of the femur moving with the shaft fragment. Patient had voluntary abduction of 15 degrees at the hip. Measurements at this time were: Distance from the anterior superior spine to the internal malleolus on the right  $33\frac{1}{2}$  inches: Distance from the anterior superior spine to the internal malleolus on the left  $30\frac{3}{4}$  inches. Patient subsequently developed an abscess of the left thigh and was admitted to Beth Israel Hospital where the thigh was incised and drained. He was admitted December 25, 1921, and discharged February 24, 1922.

Patient continued to have fairly marked pain in the left lower extremity and developed other local abscesses. He was admitted to Montefiore Home, March 22, 1922. Dr. E. D. Oppenheimer, who examined the patient after admission to Montefiore Home informed me that he thought patient had bony union at the hip. A plaster case was applied May 26, 1922, in the form of a short spica, which had to be removed on account of patient's objection. September 23, 1922, patient developed a violent hemorrhage from the hip which left him almost exsanguinated before it could be checked by packing. September 27, 1922, patient developed high fever and physical signs of pneumonia from which he died October 4, 1922. Autopsy was not obtained.

*Conclusions.*—It seems likely that this occurrence of hemorrhage spontaneously was induced by a recurrence of the tumor, which seems also likely from the X-ray appearance of the involved region as shown by the changes that have occurred between the times that the X-rays Nos. 3 and 4 were taken. The persistence of pain is likewise suggestive of malignancy. Also it would seem, notwithstanding the gross and microscopic appearances of

## PATHOLOGICAL FRACTURE OF THE NECK OF THE FEMUR

this tumor, neither of which suggested malignancy, that the tumor was nevertheless malignant.

Ewing states that "in a few instances tumors of thyroid tissue have developed under circumstances which suggested an origin from aberrant cells from the normal thyroid." He reports that Riedel removed a tumor of the inferior maxilla composed of normal thyroid tissue which recurred locally after ten years. During this period of observation the thyroid gland is said to have remained normal. In explanation of these cases it seems necessary to assume an origin either from aberrant thyroid tissue or from the normal thyroid. Comparing the structure of primary and secondary thyroid tumors, Jaeger finds that: (1) Both may be benign; (2) primary tumor malignant—secondary tumor benign; (3) primary tumor may be benign and the secondary tumor malignant; (4) both tumors may be malignant.

Pulsating bone tumors have in several instances been identified as metastatic thyroid growths. Swelling of such a tumor was interpreted by V. Eiselsberg as a menstrual phenomenon. Solitary bone metastases have been observed by V. Eiselsberg and others. That many metastatic thyroid tumors functionate is indicated by the presence of colloid.

J. Christopher O'Day says, "Insofar as we were able to determine, it would seem that an infarct of normal or rather malignant free thyroid cells is unable to proliferate outside of bony tissue while those bearing the elements of malignancy are capable of development within any tissue of the body and often with such rapidity as to have the resulting growth mistaken for the primary one." He quotes K. Kolb: "All sarcoma-like tumors in the bones,



FIG. 1.—X-ray taken June, 1920, showing rarefying osteitis at the base of the neck of the femur. Before fracture occurred.

especially in the skull, should suggest the possibility of metastases of thyroid tissue."

J. Phillip Kanoky gives an excellent bibliography of the subject under consideration and then reports a case of his own. The patient was a woman forty years old, who eight years previously had an intrathoracic tumor of the right lobe of the thyroid removed. Five years after this operation a tumor the size of a hazelnut appeared in the left parietal region. At this time the patient was operated upon but the tumor was not removed on account of the very severe hemorrhage encountered. A preliminary ligation of the

common carotid was decided upon. The patient stood this operation well but died suddenly thirty-six hours after the operation—apparently from embolus. Post-mortem removal of the tumor showed it to be thyroid. There was absolutely no evidence of malignancy.

G. E. Beilby presents an excellent classification of various types of thyroid



FIG. 2.—X-ray taken March, 1921, showing fracture at the base of the neck of the femur. Before operation.

disease. Under one group he places aberrant or metastatic thyroid tumors which are histologically benign but clinically malignant. He records the history of a man sixty-five years of age who was operated upon for a tumor involving the right antrum of Highmore. The tumor was so extensive that it could not be completely removed. It proved to be thyroid. He states: "There are now (1907) in the literature records of about twenty cases of tumors apparently metastases from the thyroid which were histologically benign. As in a number of these instances there has been no apparent thyroid lesion, these cases have been considered as metastases from normal thyroid tissue." Where a thyroid lesion has been observed it has been that of simple hypertrophy or adenoma and the metastatic tumor has had a similar histologic structure. These metastases, which may be single or multiple, have occurred most frequently in bone and have often been removed under the

## PATHOLOGICAL FRACTURE OF THE NECK OF THE FEMUR

supposition that they were primary growths. Aside from the fact that these tumors are probably of metastatic origin, they present as a rule no other indication of malignancy. Frequently, however, they have been known to recur after removal and a number of cases have thus resulted fatally. Therefore the important question arises: Are not these tumors malignant and should they not always be considered as such by the surgeon? In the case reported by Oderfeld and Steinhaus the first tumor observed was in the frontal bone. This was removed and histologically found to have the structure of normal thyroid. There was no evident recurrence after six months. After about a year there was recurrence and also other similar tumors made their appearance—one in the temporal region and one at the sternoclavicular articulation. Clinically these tumors were considered to be malignant. At the request of the patient the one in the temporal region was removed. The patient died a few weeks later. Just before death a thickening of the under



FIG. 3.—X-ray taken April, 1921, showing fracture at the base of the neck of the femur. After operation.

half of the right lobe of the thyroid was noted. A complete autopsy was not permitted, but all visible tumors were removed, together with the thyroid gland. Within the substance of the right lobe of the thyroid was found a small nodular thickening two centimetres in diameter. The remainder of the thyroid appeared normal. The tissues were all carefully sectioned and examined, the authors expecting to find carcinomatous degeneration, but the structure throughout the tumor of the thyroid and the other isolated tumors of the head and neck were uniformly the same and, as they observe, had the exact structure of normal thyroid tissue. They regard the small thyroid nodule as the primary tumor and the tumors of the head and neck as metastases.



G. Blumer states: "The thyroid tumors which give rise to bone metastases present some very marked peculiarities. While some of them are very evidently malignant, judged from their clinical manifestations alone, others show none of the ordinary evidences of malignancy. An analysis of sixty cases from the literature shows that two-thirds of the thyroid metastases occur in women and 90 per cent. of the cases between the ages of thirty and seventy. No obvious clinical involvement of the thyroid is present in at least 25 per cent. of the cases. Clinically two-thirds of the metastases are of the solitary

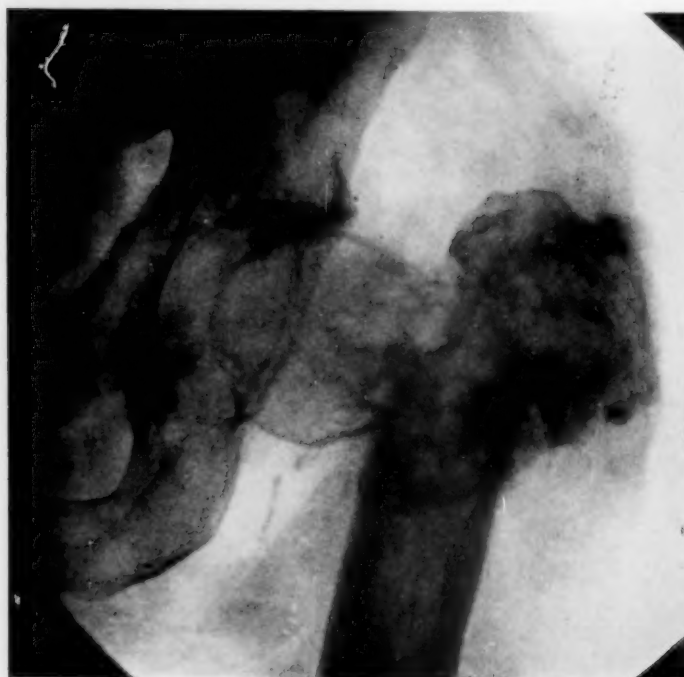


FIG. 4.—X-ray taken March 24, 1922, showing considerably greater involvement about the neck of the femur than was present when previous X-ray was made. This suggests recurrence of the tumor rather than osteomyelitis. It is also apparent that since the last X-ray was taken, further depression of the neck has occurred.

seven out of nine were in the lower jaw. Spontaneous fractures occur in 9 per cent. of the cases. The slowness of growth of the bone metastases is in some cases most remarkable and makes them unusually favorable for surgical removal. In one instance a tumor of the malar bone had been present for thirteen years; in another instance a tumor of the sternum had been present for seventeen years, and in still another case a tumor of the lower jaw had been present for ten years. Growth may be greatly accentuated by trauma or the metastases may first appear after trauma. Compared with some other bone metastases, those from the thyroid gland frequently show a comparatively low grade of malignancy. As a rule the thyroid bone metastases are exceedingly vascular and some of them

type and even at post-mortem multiple metastases are the exception. So far as distribution of the thyroid metastases is concerned: 38 per cent. of them occur in the bones of the cranium or face; 16 per cent. in the vertebræ; 10 per cent. in the femur; 9 per cent. in the pelvic bones; 7 per cent. in the sternum, and 5 per cent. in the humerus.

"Of the facial metastases

## PATHOLOGICAL FRACTURE OF THE NECK OF THE FEMUR

pulsate. For this reason they have occasionally been mistaken for aneurisms, particularly those involving the sternum, pelvis, and skull."

F. X. Dercum records the history and findings in a woman aged fifty-six years, who had a goiter for some years—just how many isn't stated. The goiter was removed August 15, 1899. Convalescence was uneventful. Goiter was of the simple type. One year after operation patient developed pain in left upper extremity. Later pains became general and wasting of muscles ensued—examination showed signs of transverse myelitis. There was a

tumor the size of a guinea egg at the left sterno-clavicular joint—it was semisolid to the touch. The spine showed two prominences—one in the upper thoracic region and another in the lower lumbar region. The patient died November 22nd. Autopsy showed a tumor mass pressing on the cord at the level of the fourth and

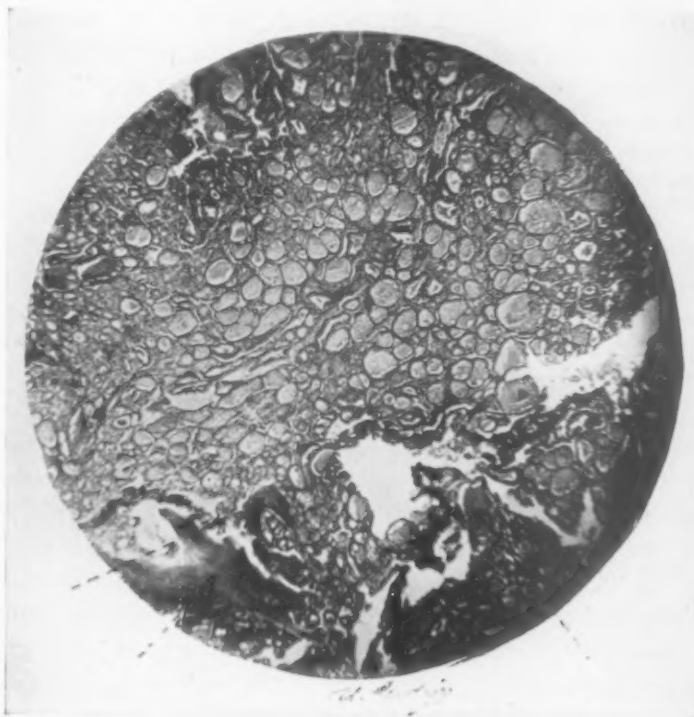


FIG. 5.—Photomicrograph (low power) of tumor tissue removed at time of operation. Dotted lines point to bone spicules in midst of thyroid tissue.

fifth cervical vertebræ and another at the second lumbar. There were tumors involving ribs as well as the sterno-clavicular joint. Only the upper spinal tumor was examined microscopically. It showed thyroid gland.

From observation made in recent years it is evident that an ordinary goiter which has existed for a long time, which has never given rise to any symptoms suggesting malignancy, may suddenly become widely diffused. These secondary tumors may be removed without any attention being directed to the primary tumor of the thyroid. Connheim, Lucke and Miller have described such cases. They were collected by Hansell in 1899. Patel reported eighteen cases of thyroid metastases. These cases were practically all associated with thyroid enlargement. Metastases were found in bones,

particularly the short and flat bones. Wolfer maintains that if a metastatic growth not only increases in size, but also takes on a destructive action upon the bone, the primary tumors cannot be considered benign even when clinical, anatomical or even histological investigations have failed to establish their malignant character.

Further it follows that such metastatic growths exert in the economy a function similar or identical with that of thyroid tissue in its normal position.

A. E. Hertzler states that: "There has been a controversy as to the possibility of a normal gland producing metastases. It has occurred in glands with slight malignancy and those cases in which metastasis has occurred from supposedly normal glands probably belong to this class. Metastasis may occur so early that the secondary tumor is regarded as primary. This indicates the importance of suspecting the thyroid whenever obscure epithelial tumors occur in regions where epithelium does not normally occur."

A. J. Ochsner and R. L. Thompson, speaking of carcinoma of the thyroid, say: "At times the structure of these malignant growths bears a close resemblance to actively proliferating goiters or even to normal thyroid gland, so that histological differentiation as to malignancy is extremely difficult or at times impossible, the metastatic nodules in the lungs, liver, bone, etc., for instance, corresponding almost identically with normal thyroid gland. Bone metastases are especially to be noted in connection with those malignant thyroid tumors which apparently find a most suitable opportunity for growth in bone-marrow. This favorable influence of bone-marrow on thyroid proliferation is borne out by the fact that such a situation is best adapted to successful thyroid transplantation."

H. G. Wells makes the statement that: "Metastasis of normal thyroid tissue and of benign neoplasms has been reported in a number of instances. This apparent exception to the rules of tumor and tissue growth would seem to be best explained in the light of the latest studies as due entirely to misinterpretation of histological pictures or to inaccurately studied cases."

An example is the report of Oderfeld and Steinhaus published as recently as 1901. This report concerned an instance in which a growth had developed in the left frontal bone, having the structure of normal thyroid gland and it did not recur after removal. In the absence of any evidence of disease in the thyroid itself this growth was believed by the writers to be the result of metastasis of normal thyroid tissue, which had proliferated in its new location as does a thyroid graft. A similar case had been reported by Riedel. In less than two years the authors named above were obliged to report an entirely different explanation. The patient had died in the meantime with multiple metastases, all of which had a structure that resembled normal thyroid. The thyroid itself showed no growth except a small encapsulated nodule which also was of the structure of normal thyroid. They were obliged to conclude that, after all, their case was one of carcinoma of the thyroid with metastases,

#### PATHOLOGICAL FRACTURE OF THE NECK OF THE FEMUR

remarkable chiefly for the resemblance of the structure of the tumor to that of the gland. A study of many cases of thyroid carcinoma shows that the metastases have a decided tendency, which is particularly true of adenocarcinoma, to reproduce the structure of normal thyroid gland follicles. It is highly probable that the above-mentioned facts are sufficient to explain the supposed instance of transportation of normal gland tissue or adenomas and that it is safe to assume that when any structure of the thyroid produces metastases, it is to be considered *prima facie* evidence of the malignancy of that structure.

## INVOLVEMENT OF THE LYMPH GLANDS IN CANCER OF THE CÆCUM

BY WINCHELL McK. CRAIG, M.D.

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AND

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FROM THE SECTION ON SURGICAL PATHOLOGY, MAYO CLINIC

IT is generally accepted that involvement of the lymph glands is a guide to the extensiveness of the operation as well as an aid in prognosis. The gastro-intestinal tract, except the cæcum and small intestine, from the stomach to the rectum has been studied in the Mayo Clinic from the standpoint of involvement of the lymph glands. In 1912, MacCarty and Blackford studied the lymph glands of the stomach, in 1920, McVay studied the rectum, and in 1921, Hayes continued the investigation in cases of cancer of the large bowel, except the small intestine and cæcum.

In considering the lymphatic drainage of the cæcum with regard to involvement in cancer, Clogg has shown that dissemination is along certain anatomic lines. He uses the classification of Jamieson and Dobson, which has also been used in this study (Fig. 1). The course of the lymphatic vessels of the cæcum is closely associated with that of the ileocolic blood-vessels. The ileocolic artery is surrounded from its origin to its division by a chain of lymphatic glands varying in number from ten to twenty and in size from about 1 mm. to 3 cm. The chain is often continuous without interspace with the gland around the superior mesenteric artery. At the point where the ileocolic artery gives off its terminal branches the chain of glands becomes broken into several groups which are associated with the branches of the artery. These groups are constant in number, though not in the number of their constituent members, and are sufficiently distinct from each other to be described in five groups. These groups form a basis for the study of the involvement of the lymph glands in cancer of the cæcum: Group 1, anterior ileocolic, Group 2, posterior ileocolic, Group 3, appendicular, Group 4, ileal, and Group 5, right colic.

The lymph vessels which drain the cæcum are simple in their arrangement, conforming to the plan of the glands (Fig. 2). However, there may be vessels which do not drain into the five groups of glands, but drain directly into those around the ileocolic artery above, and these must be kept in mind in exploring the abdomen for possible involvement.

Cancer of the cæcum originates in the glands of Lieberkühn. Around these glands are numerous lymphatics which form a thick network below. This is in combination with a second coarser network in the submucosa. The



# LYMPH GLANDS IN CANCER OF THE CÆCUM

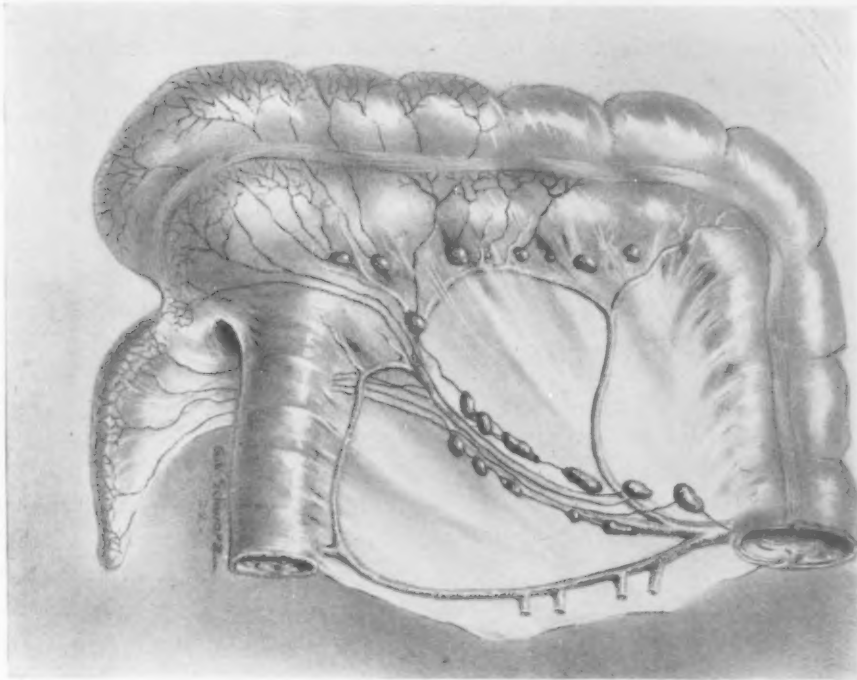


FIG. 1.—Anterior surface of cecum. Anatomic distribution of normal lymph glands. (Jamieson and Dobson.)

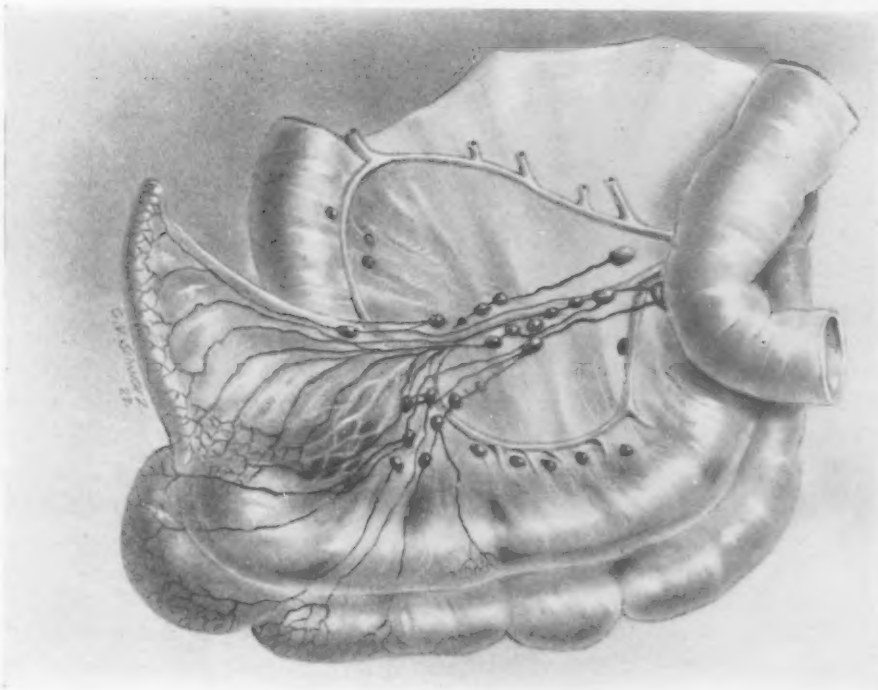


FIG. 2.—Posterior surface of cecum. Anatomic distribution of normal lymph glands. (Jamieson and Dobson.)

efferent vessels pass through the muscularis, collecting the fluid from numerous lymphatics in the muscle and form a lymphatic plexus between the layers of the mesentery (Fig. 3).

There has been some dispute concerning the involvement of the ileo-cæcal valve in cancer of the cæcum. In the literature, however, the evidence seems to show that it is involved in the greater number of cases. Mummery says that "The commonest situation of growth in carcinoma of the ileocæcal angle is at the ileocæcal valve." Ewald, in his series of sixty-four cases, found 50 per cent. involving the valve. In our series 64 per cent. had involved the valve.



FIG. 3.—(A263481). Arrangement of cells in carcinoma of the cæcum.

were first examined and records made. The lymph glands were then dissected out, particular attention being paid to the position and the anatomic distribution of the normal glands. They were all "teased out" by reducing the tissue into thin layers and transmitting the light through, in order to get the smallest as well as the largest units. As they were removed they were placed in phials, depending on their location, and their numbers and position were recorded on the charts.

The glands and sections from the original growth were studied microscopically, and the growths classified into the five groups mentioned (Fig. 4). The histories were reviewed for the purpose of checking the clinical and the pathologic diagnosis.

The cases were divided into three groups: Group 1, cases without glandular involvement; Group 2, cases with glandular involvement; and Groups 3a and b cases of colloid carcinoma, selected from Groups 1 and 2.

One hundred preserved specimens of cancer of the cæcum which had been removed at operation in the Mayo Clinic formed the basis of this study. The gross specimens, the size, form, location, extent, and character of the growth and the surrounding tissues

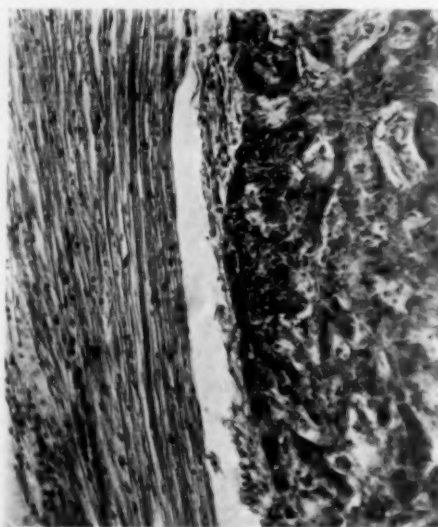


FIG. 4.—(A217584). Lymph glands showing thick capsule and carcinoma cells.

LYMPH GLANDS IN CANCER OF THE CÆCUM

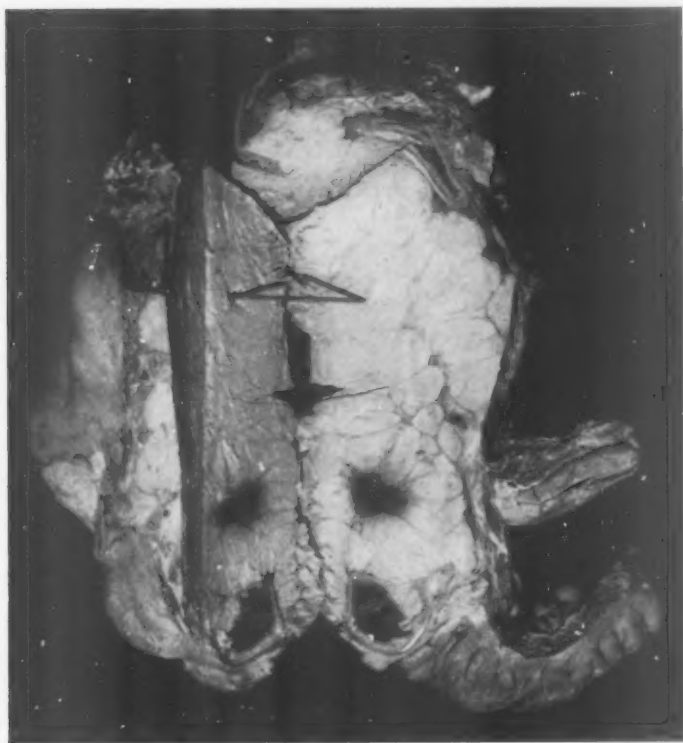


FIG. 5.—(A25392). Solid carcinoma filling lumen of the cæcum. Appendix not involved. No metastasis to regional lymph glands.



FIG. 6.—(A98833). Annular carcinoma of the cæcum which involved ileocæcal valve but did not metastasize to regional lymph glands.

GROUP 1.—*Cancer without metastatic involvement of the regional lymph glands.*—There were sixty-eight patients (68 per cent.) in this group. Twenty-three were females and forty-five were males; the average age was forty-nine years. The average number of glands in each specimen was 8.84; the total number of glands was 629. Several specimens were found with few or no glands, but as a rule the glands were numerous and large, ranging from the almost microscopical 1 mm. to that of 3 cm. (Table I.) (Fig. 5). The outstanding feature of the "inflammatory" glands was the predominance

of the posterior ileocolics, both in size and number. In only two cases were the appendicular glands enlarged, and this was probably due to appendicitis. The ileocaecal valve was involved in thirty-nine cases (50 per cent.) and in twenty cases (29 per cent.) the growth was annular or cylindrical, involving all the walls (Fig. 6).

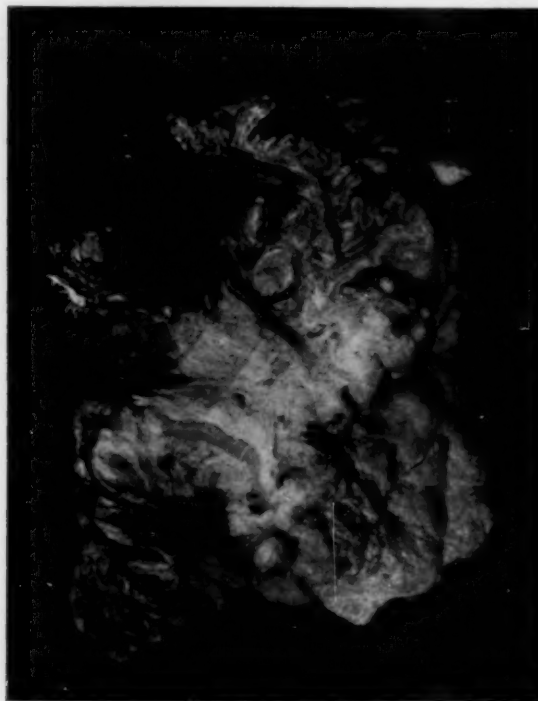


FIG. 7.—(A184960). Carcinoma of the posterior wall with involved glands. This specimen had thirteen glands, of which only six showed metastatic involvement.

of glands was 396. (Table II) (Fig. 7). Again the predominance of the posterior ileocolic glands was manifested. And further, in the thirty-two cases of involvement of the lymph glands, the posterior ileocolics were involved in twenty-nine. Nine appendicular glands were found, but none of them were the seat of metastasis. The ileocaecal valve was involved in twenty-five of the thirty-two cases (78 per cent.) and in all cases the growth was annular or cylindrical, involving the entire wall.

Primarily, all cancers of the cæcum are of the adenocarcinomatous type and the colloid variety has been regarded as a degenerative process (Fig. 8). Parham, in a recent paper, has thrown new light on this phase of the subject. After an exhaustive study of colloid cancer he concluded that a functional

GROUP 2.—*Cancer with metastatic involvement of the regional lymph glands.*—There were thirty-two patients in this group; eight were females and twenty-four males; the average age was 49.2 years. The average number of glands in each specimen was 12.3; the average number involved by metastasis in each specimen was 3.59, and the total number

# LYMPH GLANDS IN CANCER OF THE CÆCUM

TABLE I  
Group I. Carcinoma of the Cæcum Without Glandular Involvement.

Case	Sex, Age	Location	Glands	Case	Sex, Age	Location	Glands
A208874	M-62	Anterior ileocolic	4	A203094	M-59	Anterior ileocolic	4
		Posterior ileocolic	5	A204856	F-63	Anterior ileocolic	2
A156932	M-62	Anterior ileocolic	6			Posterior ileocolic	9
		Posterior ileocolic	14	A182683	F-47	Anterior ileocolic	6
		Appendicular	9	A169495	M-48	Anterior ileocolic	3
A226072	F-42	Anterior ileocolic	5			Posterior ileocolic	8
A112389	F-63	Anterior ileocolic	5	A125209	M-31	Anterior ileocolic	5
A231897	M-59	Anterior ileocolic	6			Posterior ileocolic	9
A219508	M-70	Anterior ileocolic	6	A76186	F-58	Anterior ileocolic	2
A261071	M-65	Anterior ileocolic	7			Posterior ileocolic	9
		Posterior ileocolic	5	A273156	F-58	Anterior ileocolic	3
A254414	F-63	Anterior ileocolic	4			Posterior ileocolic	9
		Right colic	2	A261786	M-43	Anterior ileocolic	5
A263481	M-46	Anterior ileocolic	2			Posterior ileocolic	3
		Posterior ileocolic	16	A224716	M-59	Anterior ileocolic	2
		Right colic	3			Posterior ileocolic	12
A274871	M-58	Anterior ileocolic	2	A290336	M-31	Anterior ileocolic	4
		Posterior ileocolic	7	A307312	M-39	Anterior ileocolic	2
A336867	M-56	Anterior ileocolic	4			Posterior ileocolic	10
		Ileal	2			Ileal	2
A40635	M-40	Anterior ileocolic	5	A48660	M-54	Anterior ileocolic	4
		Posterior ileocolic	10			Posterior ileocolic	10
A22895	M-48	Anterior ileocolic	4	A18536	M-49	Anterior ileocolic	5
		Posterior ileocolic	9			Posterior ileocolic	9
A57231	F-28	None					
A295762	M-41	Posterior ileocolic	16	A184954	F-39	Posterior ileocolic	16
A190106	F-38	Posterior ileocolic	12	A183363	M-56	Posterior ileocolic	9
A114808	M-66	Posterior ileocolic	8	A203555	M-73	Posterior ileocolic	9
		Ileal	5	A107964	M-51	Posterior ileocolic	5
A134338	M-65	Posterior ileocolic	6	A127339	M-36	Posterior ileocolic	12
A99833	F-46	Posterior ileocolic	2	A68450	F-47	Posterior ileocolic	7
		Ileal	4	A70127	F-40	Posterior ileocolic	8
A64593	M-38	Posterior ileocolic	8	A63548	M-58	Posterior ileocolic	6
A221979	M-49	Posterior ileocolic	18	A364875	F-44	Posterior ileocolic	8
A257848	M-44	Posterior ileocolic	12	A254633	M-57	Posterior ileocolic	2
		Ileal	3	A282203	F-38	Posterior ileocolic	14
A351494	M-57	Posterior ileocolic	8	A304737	M-31	Posterior ileocolic	12
A339017	F-49	Posterior ileocolic	8	A335834	M-49	Posterior ileocolic	13
A307746	M-64	Posterior ileocolic	5	A338349	F-34	Posterior ileocolic	2
A324824	F-58	Posterior ileocolic	8	A347708	M-65	Posterior ileocolic	6
A313898	M-66	Posterior ileocolic	4	A86405	M-38	Posterior ileocolic	8
A92504	F-43	Posterior ileocolic	5	A58736	F-42	Posterior ileocolic	12
A68010	M-51	Posterior ileocolic	10	A62812	F-63	Posterior ileocolic	4
A57330	F-49	Posterior ileocolic	8	A76173	M-55	Posterior ileocolic	6
A48922	M-71	Posterior ileocolic	9	A25637	M-48	Posterior ileocolic	4
A4464	F-68	Posterior ileocolic	6	A35049	M-40	Posterior ileocolic	2
		Ileal	5	A11977	M-46	Posterior ileocolic	9
A25392	M-47	Posterior ileocolic	9				
A303742	M-37	Ileal	3				



TABLE I.—Continued.  
Summary of Group 1

Patients.....	68 (68 per cent.)
Females .....	23
Males.....	45
Average age.....	49 years
Posterior ileocolic glands.....	484
Anterior ileocolic glands.....	107
Appendicular glands.....	5
Ileal glands.....	24
Right colic glands .....	5
Total number of glands .....	629
Average number of glands in specimen.....	8.84

differentiation of the cancer cells is demonstrated by the production of mucus in quantities which show that the function is uncontrolled, and that colloid cancer usually grows slowly and metastasizes late. This statement he modified by the division of colloid cancer into two groups based on the microscopic

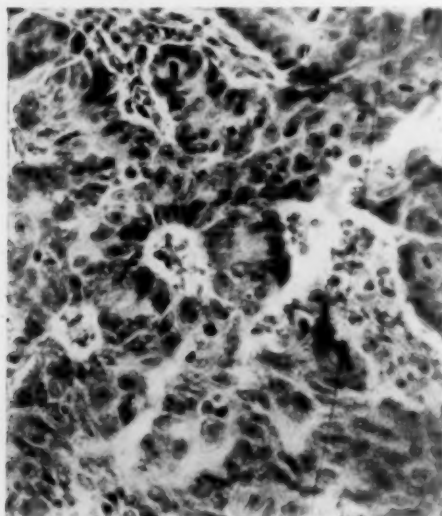


FIG. 8.—(A50540). Adenocarcinoma forming in a lymph gland. Mitotic figures present.

picture, those showing the "signet ring" types of cellular morphology being more malignant than the glandular type with columnar cells (Fig. 9.) In discussing the glandular involvement he says that local glands are commonly affected, but distant metastasis is slow. Recurrence is often localized to the site of origin, thus showing the difficulty of local eradication (Fig. 10). Twenty-two per cent. of Parham's cases of cancer of the cæcum were of the colloid type; he says "As compared to carcinoma of the cæcum in general, colloid carcinoma of the cæcum has the greater longevity."

GROUP 3A.—*Colloid cancer without metastatic involvement of the re-*

*gional lymph glands.*—There were eight patients in this group, three females and five males; the average age was forty-eight years. The total number of glands was forty-eight, and the average number in each specimen was 7.2.

GROUP 3B.—*Colloid cancer with metastatic involvement of the regional lymph glands.*—There were twelve patients in this group, two females and ten males; the average age was 49.3 years. The total number of glands was 144. Fifty-one glands were involved; ninety-three were inflammatory. The average number of glands in each specimen was twelve (Figs. 11 and 12).

#### SUMMARY

One hundred pathologic specimens and 1,033 associated lymph glands were examined.

# LYMPH GLANDS IN CANCER OF THE CÆCUM

TABLE II.

Group 2. Carcinoma of the Cæcum With and Without Glandular Involvement.

Case	Sex, Age	With	Glands	Without	Glands
A144469	M-50	Posterior ileocolic	1	Anterior ileocolic Posterior ileocolic	5 8
A217584	M-53	Posterior ileocolic	3	Anterior ileocolic Posterior ileocolic	6 11
A299507	M-60	Anterior ileocolic	1	Posterior ileocolic	10
A299107	F-66	Ileal	2	Ileal	2
A294841	M-38	Posterior ileocolic	3	Ileal	3
A338189	F-59	Posterior ileocolic	2	Posterior ileocolic	6
A321512	M-68	Posterior ileocolic	2	Posterior ileocolic	6
A8563	M-52	Posterior ileocolic	3	Posterior ileocolic	3
A28431	F-58	Posterior ileocolic	1	Posterior ileocolic	8
A11977	M-48	Posterior ileocolic	1	Posterior ileocolic Anterior ileocolic	7 10
A17527	M-52	Posterior ileocolic	2	Posterior ileocolic Anterior ileocolic Appendicular Ileal	8 5 9 4
A165146	M-53	Posterior ileocolic	2	Posterior ileocolic	9
A180796	M-42	Posterior ileocolic	2	Posterior ileocolic	8
A126319	M-54	Posterior ileocolic	2	Posterior ileocolic	4
A102581	M-49	Posterior ileocolic	1	Posterior ileocolic	9
A137095	M-47	Anterior ileocolic	2	Posterior ileocolic	6
A146060	M-68	Posterior ileocolic	6	Anterior ileocolic Posterior ileocolic	5 2
A250540	M-70	Posterior ileocolic Ileal	2 2	Anterior ileocolic	10
A31000	F-59	Anterior ileocolic Posterior ileocolic	5 1	Posterior ileocolic	5
A101909	F-60	Posterior ileocolic	6	Anterior ileocolic Posterior ileocolic	3 5
A213118	F-30	Ileal	4	Ileal	4
A207819	M-47	Posterior ileocolic	4	Posterior ileocolic	3
A207387	M-54	Posterior ileocolic Anterior ileocolic	4 3	Posterior ileocolic Anterior ileocolic	9 1
A178416	M-20	Posterior ileocolic Anterior ileocolic	2 6	Posterior ileocolic	7
A159065	M-67	Posterior ileocolic Anterior ileocolic	3 2	Posterior ileocolic Anterior ileocolic	2 12
A40635	M-40	Posterior ileocolic Anterior ileocolic	2 5	Posterior ileocolic	6
A86068	M-48	Posterior ileocolic	7	Posterior ileocolic Anterior ileocolic	3 4
A248256	M-53	Posterior ileocolic Anterior ileocolic	4 2	Posterior ileocolic Ileal	13 3
A210885	F-58	Anterior ileocolic	4	Posterior ileocolic	19
A217183	M-51	Posterior ileocolic Anterior ileocolic	2 4	Posterior ileocolic	2
A261154	M-40	Posterior ileocolic	3	Posterior ileocolic	9
A165023	F-53	Posterior ileocolic	1	Posterior ileocolic	4

## CRAIG AND MACCARTY

TABLE II.—*Continued.*  
*Summary of Group 2.*

Patients.....	32 (32 per cent.)
Females.....	8
Males.....	24
Average age.....	49.2 years
Posterior ileocolic glands involved.....	74
Posterior ileocolic glands not involved.....	192
Anterior ileocolic glands involved.....	34
Anterior ileocolic glands not involved.....	61
Appendicular glands involved.....	0
Appendicular glands not involved.....	9
Ileal glands involved.....	8
Ileal glands not involved.....	16
Glands involved.....	115
Glands not involved.....	281
Total number of glands.....	396
Average number of glands in specimen.....	12.3



FIG. 9.—(102581). Massive colloid carcinoma which involved ileocecal valve and metastasized to regional lymph glands.

Cancers without local metastasis usually protrude into the lumen of the cæcum rather than penetrate its wall, while those with metastasis usually involve the walls.

The most common site for cancer of the cæcum is the posterior wall. Cases of annular cancer, or those in which all the walls were involved, comprised nearly 43 per cent. of this series. In 35 per cent. the growth was confined to the posterior wall. This accounts for the fact that metastasis and inflammatory reaction are most often found in the posterior ileocolic lymph glands. The growth was confined to the anterior wall in 13 per cent. of the cases.

Colloid cancer occurred in 20 per cent. of the cases. It

metastasized in 12 per cent. and was often present in the most highly malignant cases.

The ileocecal valve was involved in 64 per cent. of the cases.

Sixty-six per cent. of the cases were males, and 34 per cent. females.

In 32 per cent. of the cases there was metastatic involvement of the regional lymph glands.

# LYMPH GLANDS IN CANCER OF THE CÆCUM

TABLE III.

Group 3a. Colloid Carcinoma of the Cæcum Without Glandular Involvement.

Case	Sex, Age	Location	Glands
A22895	M-48	Anterior ileocolic Posterior ileocolic	4 9
A274871	M-58	Anterior ileocolic Posterior ileocolic	2 7
A70127	F-40	Posterior ileocolic	8
A254414	F-63	Posterior ileocolic	11
A92504	M-43	Posterior ileocolic	5
A336867	M-56	Posterior ileocolic Anterior ileocolic	6 4
A339017	F-49	Posterior ileocolic	2
A303742	M-37	Ileal	3

## Summary of Group 3a.

Total number of patients	8 (8 per cent.)
Females	3
Males	5
Average age	48 years
Posterior ileocolic glands	48
Anterior ileocolic glands	10
Ileal glands	3
Total number of glands	61
Average number of glands in specimen	7.6

Lymph glands were found which were normal in consistency, yet palpable and plainly visible to the naked eye.

The size of the intestinal lesion, and the size and number of the regional lymph glands proved to be no criterion of the presence or absence of metastasis.

Lymph glands, simulating cancerous glands in size, due to marked cellular infiltration and lymphedema, were found to be inflammatory.

Glands, too small to be palpated at the time of operation, were found to be the seat of metastasis.

In cases of glandular involvement large and numerous inflammatory glands were also noted, which could only be distinguished by the use of the microscope.

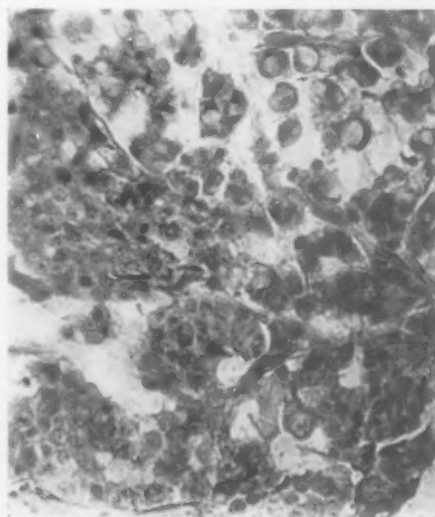


FIG. 10.—(A501909). Colloid carcinoma (signet-ring type). (X200.)

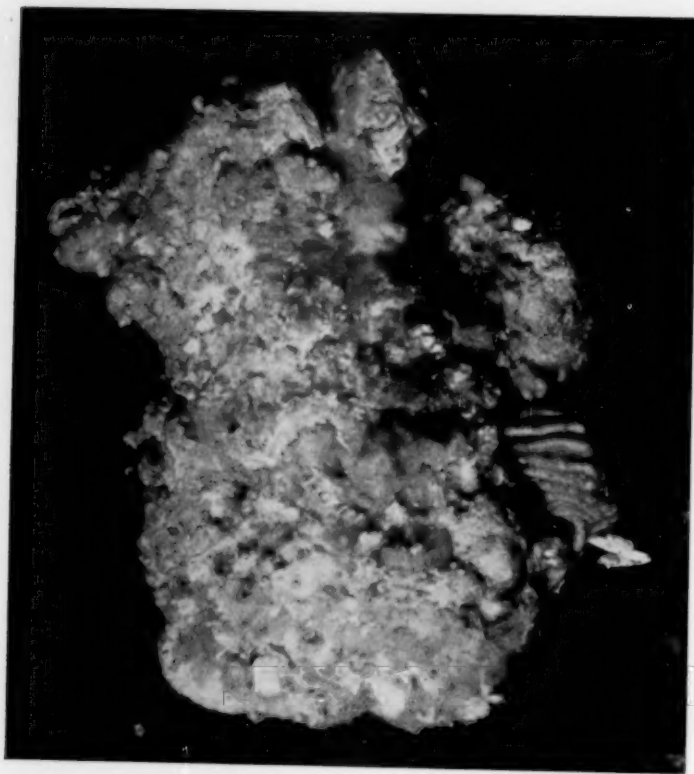


FIG. 11.—(A339017). Colloid carcinoma filling cæcum and involving ileocecal valve; the regional lymph glands were free from metastasis.

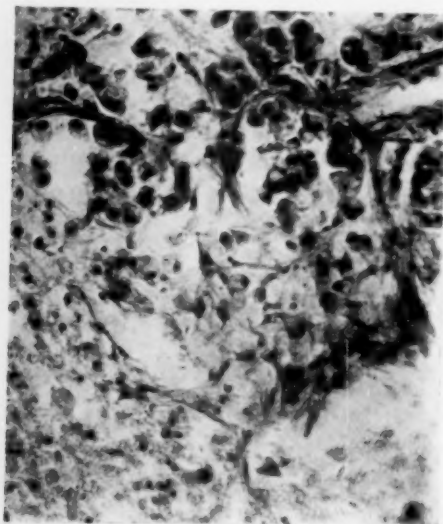


FIG. 12.—(294841). Metastasis in a lymph gland from colloid carcinoma. (X150.)



# CRAIG AND MacCARTY

In cases of low malignancy clinically, without metastasis, were local glands, larger and more numerous than in the more highly malignant cases showing metastatic involvement.

In cases with a large number of glands involved pathologically, a high degree of malignancy was usually proved clinically.

Predominance of the posterior ileocolic lymph glands is of significance, and should prove of value in the operating room, since 71 per cent. of all glands found were in this region, and 64 per cent. of the glands which showed metastatic involvement belonged to this group.

Systematic microscopic examination is the only method of determining the presence of local or regional metastasis.

TABLE IV.

Group 3b. Colloid Carcinoma of the Cæcum With and Without Glandular Involvement.

Case	Sex, Age	With	Glands	Without	Glands
A144469	M-50	Anterior ileocolic Posterior ileocolic	5 8	Posterior ileocolic	1
A165146	M-53	Posterior ileocolic	2	Posterior ileocolic	9
A102581	M-49	Posterior ileocolic	1	Posterior ileocolic	9
A264202	F-57	Posterior ileocolic	3	Posterior ileocolic	4
A321512	M-68	Posterior ileocolic	2	Posterior ileocolic	6
A178416	M-20	Posterior ileocolic Anterior ileocolic	2 6	Posterior ileocolic	7
A160796	M-42	Posterior ileocolic	2	Posterior ileocolic	8
A126319	M-54	Posterior ileocolic	2	Posterior ileocolic	4
A299507	M-60	Posterior ileocolic	1	Posterior ileocolic	10
A213118	F-30	Ileal	4	Posterior ileocolic Ileal	5 4
A146060	M-68	Posterior ileocolic	8	Anterior ileocolic Posterior ileocolic	5 8
A207819	M-47	Posterior ileocolic	4	Posterior ileocolic	3

## Summary of Group 3b.

Total number of patients.....	12 (12 per cent.)
Females .....	2
Males .....	10
Average age.....	49.3 years
Posterior ileocolic glands involved .....	34
Posterior ileocolic glands not involved.....	74
Anterior ileocolic glands involved.....	11
Anterior ileocolic glands not involved.....	5
Ileal glands involved .....	4
Ileal glands not involved.....	4
Glands involved.....	51
Glands not involved .....	93
Total number of glands .....	144
Average number of glands in specimen.....	12

# LYMPH GLANDS IN CANCER OF THE CÆCUM

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## CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD AND ADOLESCENCE

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It is generally considered that epithelial cancer of the terminal portion of the large intestine is confined to middle-aged and elderly subjects. This is undoubtedly true, since the number of such cases occurring in childhood and adolescence recorded in medical literature is strictly limited, and although some authors have admitted the occurrence of malignant disease in young persons they have commonly included sarcomas and other non-epithelial tumors.

Steiner,<sup>1</sup> in 1865, stated that Henning observed but 12 cases of cancer among 1,000,000 living children, under the age of 15 years, 6 of them between the ages of 5 and 10 years and 6 between 10 and 15 years. Von Bergmann<sup>2</sup> says that it is a remarkable fact that rectal cancer occurs in children, even in those less than 10 years of age, and he thinks it may perhaps be explained by the frequency of adenoid growths in children. Weinlechner<sup>3</sup> in 5279 cases of carcinoma observed 18 (0.34 per cent.) among children up to 14 years of age. Feldner<sup>4</sup> in 914 cases of carcinoma, met with only 3 up to the 16th years of life.

Inasmuch as authors differ somewhat in regard to the different pathological types of malignant tumors of the bowel and as the classification of tumors is largely arbitrary, Rose and Carless<sup>5</sup> suggest the following classification, which is based partly on the structure of the tumor and partly on the tissue from which it originates.

- |                           |   |
|---------------------------|---|
| 1. Epithelial             | (a) Squamous-celled<br>(b) Epithelioma                                  |
| 2. Cuboidal or spheroidal | (a) Scirrhus<br>(b) Fibrous carcinoma<br>(c) Hard cancer<br>(d) Acinous |
| 3. Columnar               | (a) Cylindrical<br>(b) Malignant adenoma<br>(c) Adenoid cancer          |
| 4. Medullary              | (a) Encephaloid<br>(b) Soft<br>(c) Acute                                |

Columnar carcinoma is in the majority of cases a glandular cancer and is found more frequently in the alimentary canal. The so-called colloid cancer

TABLE I.  
*Synopsis of Reported Cases.*

Case No.	Reported by	Sex and age	Symptoms and diagnosis	Treatment and findings	Results	Remarks
1	Mayo, H. Observations on injuries and diseases of the rectum. 1853, p. 188	M 12	Not stated	Not stated	.....	This refers to a carcinoma of the rectum seen in a patient aged 12 years.
2	Bushe, G. Treatise on the malformations, injuries and diseases of the rectum and anus. 1857, p. 202	M 12	Not stated	Not stated	.....	Bushe states, "That he has seen the encephaloid transformation in a boy 12 years old."
3	Cummings, J. P. C. Malignant disease of the rectum in a boy of 12. <i>Am. Jour. Med. Sc., Phila.</i> 1854, lvi, p. 352	M 12	Acute dysentery. Pain in rectum, frequent small discharges sometimes 20 per diem. 3 months later great tenesmus and inability to evacuate bowels. After using cathartics for 3 days without results, examination per anum showed tumor	Not stated. Autopsy findings colloid carcinoma	Death	The malignancy involved the entire circumference of the intestine more or less to the extent of 2 inches.
4	Pillon, A. Retractionnement cancéreux du rectum chez une jeune fille de seize ans et demi. <i>Bull. Soc. anat. de Paris.</i> 1856, xli, p. 434	F 16½	Seriously ill for about 3 months, no abdominal antecedents, obstinate constipation. Yielded only to energetic treatment. Stools glairy and bloody	Not operated; autopsy finding cancer.	Death	Autopsy: The rectum was thickened from the sacro-iliac symphysis to its ampullar dilatation and invaded by a thick white tissue. The perirectal tissues were involved. Pathologically examined.
5	Steiner. Areolarkrebs des dickdarms bei einem neunjährigen Knaben. <i>Jahrb. f. Kinderh.</i> Leipzig, 1865, vii, p. 61	M 9	Sudden crises of intestinal occlusion suggesting volvulus or invagination	Not operated; autopsy finding alveolar epithelial cancer	Death	Autopsy: Stenosis of the first portion of the iliac sigmoid. Microscopically verified.
6	Leijer. Enterotomi ved cancer recti. <i>Hygea.</i> Stockholm. 1872, xxxix, p. 138	M 9	Previous history healthy and strong. Violent pain in abdomen from lifting a heavy weight. Digestive trouble and constipation followed. Patient constipated for 8 days, considerable meteorism and pain developed	Artificial anus. Autopsy finding alveolar epithelial cancer	Death 11 days later	Autopsy: Fistula led into upper part of sigmoid flexure. Intestines above not affected, but filled with fecal matter. S. Romanum filled with stone-hard lumps of feces. Rectum hard, fibrous, difficult to remove and it was adherent to the surrounding parts. Other abdominal organs anemic without cancerous deposits. Microscopically verified.

# CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD

7	Marchand. Étude sur l'extirpation de l'extrémité inférieure du rectum. Paris. 1873. Case quoted by Schoening	F 12	Tumor in anus from 10th to 13th year; disappeared then. Past 9 months pain in rectum and abdomen and bloody stools. Tumor felt on inserting finger in rectum; ring formation in lower part of rectum with stenosis	Tumor first treated by crushing. Later extirpation. Carcinoma	Death by suppuration and peritonitis	No mention of the nature of tumor. Schoening thinks sarcoma but excluded and that it was similar to a case of rectal carcinoma observed in the Rostock Clinic.
8	Mollière, D. Traité des maladies du rectum et de l'anus. 1877, p. 505	F 19	Tumor primarily developed in the rectum with rapid ascending extension along the intestine in the region of the iliac sigmoid	Cancer	Death	No further particulars.
9	Godin. Quoted by Mollière. <i>Ibid.</i> , p. 520	15				Godin observed a case of scirrhous cancer in the rectum in a child 15 years old.
10-12	Billroth, Th. Chirurgische Klinik. Berl. 1878, p. 299	18-20				Billroth mentions 3 cases of carcinoma of the rectum in patients from 18-20 years old. No details given.
13	Allingham. Diseases of the rectum. 1879, 3d, ed. p. 205	M 17			Death	Allingham saw an encephaloid rapidly fatal in a lad 17 years old.
14	Gowland. Quoted by Allingham. <i>Ibid.</i>	M 13				Gowland observed a case of cancer of the rectum in a boy 13 years old.
15	Dubat, L. Carcinome colloïde de l'Sillaque chez un jeune homme de 19 ans. Laparotomie anua contre nature. Bull. et mém. Soc. anat. de Par., 1879, liv. p. 644	M 19	No important antecedents. Sudden abdominal pains, vomiting and diarrhoea. Did not persist and only slight for next 2 months. Some constipation, nausea and pains; bilious vomit. Constant purgatives necessary	Laparotomy. Artificial anus. Autopsy findings. Colloid cancer	Death	Autopsy: Tumor size of egg occupied the middle part of the iliac sigmoid colon. Intestinal walls much thickened about tumor. No trace of metastases. Microscopically verified.
16	Ahfeld. Arch. f. Gynaek. Berl. 1880, xvi, p. 141	Newborn monster		Autopsy finding cancer	Death	Case of a newborn monster. Tumor at termination of large intestine. Microscopically cancer.
17-18	Gurlt, E. Beitrag zur chirurgischen statistik. Arch. f. klin. Chir. Berl. 1880, xxv, p. 421	13-19				Gurlt observed 2 cases of carcinoma of the rectum. No details given.
19	Forbes. Quoted by Cripps. Cancer of the rectum. London	M 17		Not stated	Death	The progress of the disease was so rapid in this case that the period from the onset of the symptoms to death was only 8 months



TABLE I.—Continued.  
Synopsis of Reported Cases.

Case No.	Reported by	Sex and age	Symptoms and diagnosis	Treatment and findings	Results	Remarks
20	Heuck, G. Zur statistik und operative behandlung der mastdarmkrebs. Verhand. d. deutsch. Gesellsch. f. Chir. 1883, xii, p. 183	M 18	Bowels moved with great difficulty, accompanied by extreme pains in back and abdomen, and discharge of mucus	Operation. Thermo-cautery and later colotomy. Autopsy finding, gelatinous-cylindric cell carcinoma	Died of exhaustion	Duration of illness 17 months.
21	Hayd, H. Scirrhus cancer of the rectum in a boy 18 years old. Buffalo M. and S. J. 1883, xxii, p. 497	M 18	Chronic diarrhoea. Pale, anemic, emaciated. For 1½ years uneasiness and pain on defecation, passed blood occasionally. Eventually a violent and nearly fatal hemorrhage. Pain increased, hemorrhages repeated attacks of constipation with diarrhoea, accompanied with great tormina, and at last tenesmus	Palliative laxatives and morphia. Operation impracticable	Death	Notwithstanding the large size of the growth and the involvement of the abdominal lymphatics, those in the groin along Poupart's ligament and beneath it and in Scarpa's triangle were unaffected.
22	Schoening, G. Ueber dar Vorkommen des mastdarmkrebs in den ersten beiden Lebensdecennien. Deut. Ztschr. f. Chir. Leipz. 1883. xxii, p. 36	F 17	Gastro-intestinal trouble since 7th year, mucus in the stools defecation difficult and usually accompanied by bleeding, sometimes clots. Examination showed the rectum and lower colon strictured, hard and infiltrated and bled easily; a mass between rectum and vagina. Diagnosed as rectal carcinoma	Extirpation of mass. Autopsy findings. Alveolar celled carcinoma	Death	Autopsy: Lower part of rectum and sigmoid flexure strongly stenosed and walls infiltrated and adherent to sacrum, uterus, etc. Microscopically verified.
23	Ibid.	F 17	Constipated, feces passed with difficulty. A movement in 8 days only with great pain. Tumor in vicinity of the tumor of the ischium and posteriorly to coccyx; labia adematous; tumor not movable. Pushing of finger in rectum difficult; a hard ring could be felt in the posterior rectum; lumen of rectum much stenosed	Exploratory operation. Biopsy: Cylindric cell carcinoma	Death	No autopsy. Obstinate obstipation was the noteworthy early symptom in this case. Microscopically verified from biopsy.

# CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD

24	Michaux. Trans. Acad. Med. Richmond, Va. 1890. Quoted by Williams	M 15	.....	.....	.....	.....	Michaux saw a case of colloid carcinoma of the rectum in a boy 15 years old.
25	Hastings. Quoted by Cripps	M 18	Duration of illness 4 months	Colotomy	Patient lived 10 months after operation	.....	Mother of patient also died of rectal cancer 5 years after his death
26	Wilde, M. Ueber das Vorkommen des Krebs bei jugendlichen Individuen. Inaug. Diss. Kiel. 1892, 19 pp.	M 15	.....	.....	.....	.....	No details given. The author saw a case of cancer of the rectum in a boy 15 years old.
27	Israel. Quoted by Phillips, 1892	M 14	.....	.....	.....	.....	Israel saw a case of colloid cancer in the sigmoid flexure in a boy 14 years old. No details.
28	Stern, C. Zur Kenntnis maligner Neubildungen im Kindersalter deutsche med. Wchnschr. Berl. 1892, xviii, p. 494	F 11	Ileus.	Operated. Cyclindric cell carcinoma	Death	.....	In the rectum, about 10 cm. from the anus a circular 4 cm. high growth pressing against the intestinal wall having on its lower surface a number of small nodules. Microscopically verified.
29	Platt, J. F. On excision of the rectum for cancer with records of 21 cases. Med. Chronicle. 1894, n. s. 1, p. 419	M 19	Symptoms of rectal disease for 8 months before admission. Tumor involving the posterior wall of the rectum 1½ inches above anus	Operation. Bowel resected including tumor. Epithelioma	Recovery	.....	3 inches of bowel removed.
30	Czerny. Mastdarmkrebs bei einem 13 Jahr. Knaben. München. med. Wchnschr. 1896, xliii m, p. 241	M 13	Tumor developed in large intestine during last 1½ years	Operation. Cyclindrical epithelial cancer	.....	.....	Tumor reached some 4 inches into intestinal canal. The growth extended to Douglas sac through the muscularis.
31	Garrard, W. A. Case of carcinoma of the colon occurring in a child. Quart. M. J. Sheffield 1896, v, p. 234	M 12	Constipation until last 6 days. Complete obstruction with pain, vomiting, distention, passed no blood or mucus. Abdomen distended and tympanic, visible peristalsis, distended bowel felt pressing into the rectum, no stricture felt	Operation. Sigmoidal tumor. Autopsy findings. Colloid columnar cell carcinoma	Death	.....	On account of the age cancer not surmised. Autopsy: Growth in sigmoid had closed it completely for 1½ inches, meso-colon infiltrated. Cecum, appendix, and a coil of ileum adherent to abdominal wall by a deposit growth. Microscopically verified.
32	Matthews, J. M. Quoted by Tuttle	F 17	.....	Carcinoma	Recovery	.....	Recurrence in 2 years.
33	Cesach P. Beitrag zur Statistik der Rektumcarcinoma Inaug. Diss. Breslau. 1897	M 18	Blood in stools since childhood, Diarrhea for 8 months	.....	.....	.....	Cesach includes in his statistics a case of rectal carcinoma in a youth of 18.

TABLE I.—Continued.  
Synopsis of Reported Cases.

Case No.	Reported by	Sex and age	Symptoms and diagnosis	Treatment and findings	Results	Remarks
34	Paulkauf, R. Carcinom der Flexura sigmoidea von einem zwölfjährigen Mädchen. Wien. klin. Wchnschr. 1900, xiii, p. 197	F 12	.....	Autopsy findings. Cyclindric cell epithelioma	Died of acute ileus	Tumor of the sigmoid with metastases in liver and peritoneum found at autopsy. Microscopically verified.
35	Zupinger. Der Darmkrebs im Kindersalter. Wien. klin. Wchnschr. 1900, xiii, p. 389	F 12	Suffered for 3 months from abdominal pains; diarrhoea, melena, tense painful abdomen; anal fissure. Tumor palpated rectum. Absolute constipation	Autopsy findings. Cyclindric cell epithelioma	Death	Metastases in liver and peritoneum. Stenosis and ulceration of sigmoid. Microscopically verified.
36	Marsh, F. Carcinoma of the sigmoid flexure in a boy aged 15 years. Lancet. Lond., 1902, i, p. 379	M 15	Pain in epigastrium and passing of blood in stools, 6 months prior. Per rectum an indistinct fullness could be felt to the left in the rectovesical pouch. Blood and mucus followed examination	Operated. Growth excised, as well as enlarged glands; intestine anastomosed to upper part of rectum. Columnar cell carcinoma	Recovery	Microscopically verified.
37	Parkinson, J. P. Colloid cancer in a girl of 12. Lancet. Lond., 1903, i, p. 1525	F 12	Abdomen was distended with free fluid; thought to be suffering from tuberculous peritonitis	Autopsy finding. Colloid cancer	Death	The primary seat of the growth believed to have been the rectum. Microscopically verified.
38	Rohde, E. Über Krebs im jugenlichen Alter. Inaug. Diss. Griefswald. 1904	M 19	Blood in stools since childhood. Anal tumor appeared after defecation and had to be pushed back. Pain later with blood and mucus in stools	Operated for polyps by galvanic and thermo-cautery. Radical operation with artificial anus. Cancer	Death	Microscopically verified.
39	Grulee, C. G. Carcinoma in early life with the report of carcinoma of the rectum in a girl 16 years old. Surg. Gynec. & Obst. Chicago. 1906, ii, p. 678	F 16	Patient weak and undeveloped since birth. Pain in lower part of abdomen, more severe in left iliac region, bright red blood in stools. Very constipated, anorexia and vomiting	Adenocarcinoma	.....	Microscopically verified from biopsy.
40	Lazarus-Barlow, W. S. "Cancer Ages." A statistical study based on the cancer records of the Middlesex Hosp. Arch. Middlesex Hosp. London. 1905, v, p. 30	M 16	Digital examination revealed a large growth in the rectum	Colloid	Death	Diagnosis not confirmed by autopsy or microscopic examination.

# CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD

41	Bernouilles. Magen-Darmkrebs in den beiden ersten Lebensjahren. Inaug. Diss. Biele. Quoted by Baur and Bertin	M 13	Case diagnosed as invagination	Not operated. Autopsy finding alveolar carcinoma	Death	Autopsy: Peritonitis; stenosis (11 cm.) of superior part of sigmoidal loop. Microscopically verified.
42	Cripps, Harrison. Diseases of the rectum and anus. 1907	M 14	Duration of illness 2 months. Mass felt 3 inches above anus	Palliative	Died 3 months later	
43	Clogg, H. S. Cancer of the colon, a study of 72 cases. Lancet. Lond. 1908, ii, p. 1007	15				Of the 72 cases of colon cancer collected by Clogg one was in a child aged 15 years.
44-47	Porter, M. F. Cancer of the rectum and lower sigmoid, with the report of a Unique case. New York M. J. 1912, xcv, p. 264	14-17				Porter states that of 113 cases of cancer of the rectum at the Rostock Clinic, 4 occurred in patients between 14 and 17 years of age.
48	Barber, W. H. Intestinal obstruction caused by adenocarcinoma of the sigmoid in a boy of 19. Interstate M. J. St. Louis. 1919, iii, p. 106	M 19	Symptoms of acute intestinal obstruction. Suffered from intestinal cramps. Always constipated, but no pain upon defecation until the past year. Vomited persistently for 2 days before entering hospital. No blood in vomitus. nor in colonic washings. Abdomen markedly distended, generally rigid and tender	Operated carcinoma	Operative recovery	Extensive glandular metastases in the mesosigmoid and in the preaortic lymphatics. Microscopically verified.
49	Olmsted, I. Carcinoma of the lower part of the sigmoid in a boy 14 years of age. Tr. Am. Surg. Assn., Phila. 1921, xxxix, p. 24	M 14	Pain in abdomen, frequent stools of blood and mucus, with rectal tenesmus	Operation. Adenocarcinoma	Recovery	Histological examination showed varied forms of atypical growth of gland epithelium and epithelial cells. Microscopically verified.

results from a degeneration of the epithelial cells of a glandular cancer and is thus found associated with epithelioma, scirrhus, medullary and columnar cancer and should be so regarded instead of a separate type as mentioned in some of the appended reports.

The site of the lesion is usually three or four inches above the anus, although it is frequently found in the rectal pouch.

I have recently observed the following case, which was referred to me by my assistant, Dr. I. Kaufman.

Male, aged nineteen. Previous illness, negative until six months ago, when he began to lose weight, which has lately been so rapid that it caused him to discontinue his employment three weeks ago, since which time he has had a pronounced diarrhoea, six to twelve stools per day, consisting largely of mucus and shreds, rarely, but occasionally, stained with blood. There was a marked anorexia, distention, tenderness, frequent vomiting, severe pain in abdomen and frequent micturition.

Physical examination: Temperature, 100; pulse, 100; respiration, 22. Marked emaciation, facial expression markedly hippocratic. Abdomen greatly distended, board-like rigidity, tympanitic, slight œdema of the lower limbs, slight dulness in both flanks, pronounced tenderness over entire abdomen more so in left iliac region. Rectal examination, empty, negative to palpation. Blood findings: Red blood cells, 2,760,000; white blood cells, 13,200; hæmoglobin, 60; coagulation, 5 minutes. Differential count: Polymorphonuclears, 74 per cent.: small lymphocytes, 24; large, 2 per cent. Achioma present. Poikilocytes present. No other pathological cell changes. Urine highly acid, otherwise negative. Diagnosis of partial obstruction possibly due to tubercular peritonitis was made, and operation advised and accepted.

Operation: Midline celiotomy inspection showed entire colon distended about size of his thigh, abdominal cavity filled with a sero-purulent fluid with mass causing obstruction located in sigmoid. An emergency drainage was established in the iliac colon and wound partly closed. Patient expired eighteen hours later.

Autopsy revealed a hard, irregular tumor mass, located about middle of the pelvic colon, firmly adherent to bladder and surrounding structures. Growth causing almost complete closure of sigmoid. A few abdominal lymphatic glands and mesenteric glands enlarged. Histological examination showed the tumor mass to be a columnar carcinoma.

*Resumé.*—Rapidly developing and fatal columnar carcinoma of the sigmoid in a male patient nineteen years, the chief symptom, being abdominal pain, vomiting, distention and diarrhoea.

Bernouille,<sup>6</sup> in 1907, reviewing 50 cancers of the digestive tract in subjects less than 20 years old, found that 29 involved the sigmoid or rectum. Many of these cases do not appear to have been verified.

In a careful search through the literature I have found 49 cases of cancer of the rectum or sigmoid in children and adolescents under 20 years old; resumé of each is to be found in the appended Table I; 23 were in males,



## CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD

13 in females, and in 13 cases the sex is not stated. The age incidence is as follows:

Under 1 year (monster) .....	1
From 1 to 5 years .....	0
From 6 to 10 years .....	1
From 11 to 15 years .....	22
From 16 to 20 years .....	25
Total .....	49

*Etiology.*—In the young as in the adult, intestinal cancer of the lower digestive tract seems to have a marked predilection for the sigmoid. This perhaps may be explained by the fact that in the young the rectal region is more adapted as a region where intestinal contents stagnate than other portions of the intestine. Traumatism is only very exceptionally noted as a cause either revealing a lesion up to the latent or else aggravating a pre-existing neoplasm.

What strikes one in reading the histories of these cases is the rapidity of evolution of the cancer. From the time that the first symptoms were clearly evident until death 7 to 8 months, rarely more elapsed. The affection in the young is therefore almost fulminating.

*Symptoms.*—The early symptoms of cancer of the rectum are often very obscure, and vary according to the situation of the growth, and ulceration involved. The established symptoms are constipation, diarrhoea, tense, tympanitic abdomen, gastro-intestinal disturbances, pain, melena, and intestinal occlusion. Pain is usually the earliest symptom, being generalized over entire abdomen, as in the case reported. Melena is more or less frequent. Usually the case sooner or later shows acute ileus, and more especially when the cancer is in the sigmoid. The well-developed musculature of the sigmoid predisposes it to spasm which causes the acute occlusions in cases of cancer. In several instances obstinate constipation was noted, but on the other hand diarrhoea, as in the present case, was more prominent. Rectal palpation does not usually furnish any clear indications; in the present case it was negative.

*Diagnosis.*—Of the 49 cases only 7 were pre-operatively diagnosed as cancer; in 1 the diagnosis was uncertain; 1 was diagnosed as invagination; 2 as obstruction; 1 in a newborn monster; 13 were found post-mortem, and in 23 cases no diagnosis is stated. The young age of the patient generally excluded the idea of cancer.

*Course.*—Of the 49 cases, 26 died, 3 recovered, and in 20 the result is not clearly stated.

*Metastases.*—Metastases of rectal and sigmoidal cancer are rare in young patients and were observed clinically on palpation in but very few cases. They were usually autopsy findings, more particularly noted in the liver, mesentery, lung, spleen, peritoneum, and lymph-glands, the last being the most frequent.

*Treatment.*—Palliative treatment offers very little in these cases. The majority of these cases are not diagnosed until late if at all. In many of them the abrupt onset of the terminal acute clinical history precludes the possibility of anything except radical interference.

The application of radium intra-sigmoid or intra-abdominal is of doubtful value, even in the most favorable cases—possibly as a preparation for operation—this is, however, questionable. The use of deep X-ray therapy is in its infancy and remains to be developed.

However, supportive feeding and elimination should not be overlooked. The diet should be bland and non-irritating, consisting of milk, fruit juices, concentrated liquid foods. Elimination should forbid cathartics and rely upon clysters of oil and water under low pressure, precaution should be taken not to damage or perforate the intestinal wall. The use of antiseptics is likewise commended.

The operative measures employed have usually been the procedures well established in such cases. The establishment of an artificial anus, colostomy, and resection of the neoplasm with the portion of the intestinal tract involved. When indicated, if the patient is in a good general state, colectomy offers the best chance of complete success and avoidance of recurrence; if the neoplasm is not far advanced in evolution and the system not yet intoxicated, resection should give favorable results in young patients.

Of the 49 cases here reported 15 were operated; of these 8 died post-operatively; in 1 the result is not stated. There were 3 post-operative recoveries, of which 1 is stated to have died within a short time later.

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## SARCOMA OF THE OMENTUM

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PRIMARY tumors of the omentum are rare and primary sarcoma of the omentum is extremely rare. Text-books of surgery and pathology give remarkably little on the subject. Some authors deny that sarcoma is ever found as a primary growth in the omentum and claim sarcoma found there to be secondary to that of the peritoneum, stomach or colon. The few recorded cases are sufficient to prove its existence as a primary tumor of the omentum. Carcinoma is not primary in the omentum. Such growths are either secondary carcinoma or endothelioma. The gross appearance of the different omental malignant tumors may be very similar. While such tumors may be very vascular, they tend to disorganize and the cells to disintegrate into gelatinous material, as so frequently seen in metastatic carcinoma or so-called colloid cancer. Cyst formation of omental tumors is frequent. Hemorrhages into such cysts have been described a number of times. Hydatid and dermoid cysts occur; the great omentum being an extremely favorable situation for hydatid cysts. Other benign tumors of the omentum are lipoma, fibroma and lymphangioma. They seem to occur less frequently than sarcoma.

In 1906, Cobb collected reports of 14 authentic cases, including one of his own, of primary sarcomata of the omentum. Bonamy and Bonamy in 1908 collected the reports of 16 cases and Karsner in 1911 reported an additional collection of 7 cases and added as his own a report of a primary endothelioma of the great omentum. Sten von Stapenohr in 1918 succeeded in collecting 49 primary sarcomata of the omentum. Aimes in 1920 reports a total of 53 such tumors. Smital and Segers each have recently reported cases. The total number of reported cases is probably still below 60.

The following is a report of another primary sarcoma of the great omentum with metastasis to the liver:

*Case Report.*—Surgical No. 11465, negro, male, forty-four years of age, was sent to the Barnes Hospital from the Washington University Dispensary with the diagnosis of carcinoma of the stomach. His chief complaint was vomiting, pain in abdomen, weakness and loss of weight. Onset of illness was two months prior to admission to the hospital with vomiting and severe abdominal pain associated with chills and fever. The vomitus was generally of the "coffee-ground" type. Approximately five weeks later he noticed an increase in the size of his abdomen. The enlargement of the abdomen increased and he continued to have intermittent vomiting, abdominal pain and loss of appetite and weight.

Examination showed him to be poorly nourished. Breath sounds were diminished at the base of the lungs. The abdomen was distended and an indefinite

tender mass could be palpated in the upper left quadrant extending over to the midline. The mass moved with respiration. The liver edge was palpable 6 cm. below the costal margin. The surface of the liver was rough and tender. There was dullness on percussion over the entire left abdomen and in the right flank a fluid wave was demonstrated. Genitalia, extremities and rectal examination negative.

Blood Wassermann negative. Blood-pressure 130-90. Phenolsulphonephthalein excretion, 45 per cent. in two hours. Red blood-cells, 3,500,000; white blood-cells, 14,000; hamoglobin, 80 per cent. Sahli. Temperature, 37° C.; pulse, 132; respiration, 24. Urine showed a trace of albumen and contained many white blood-

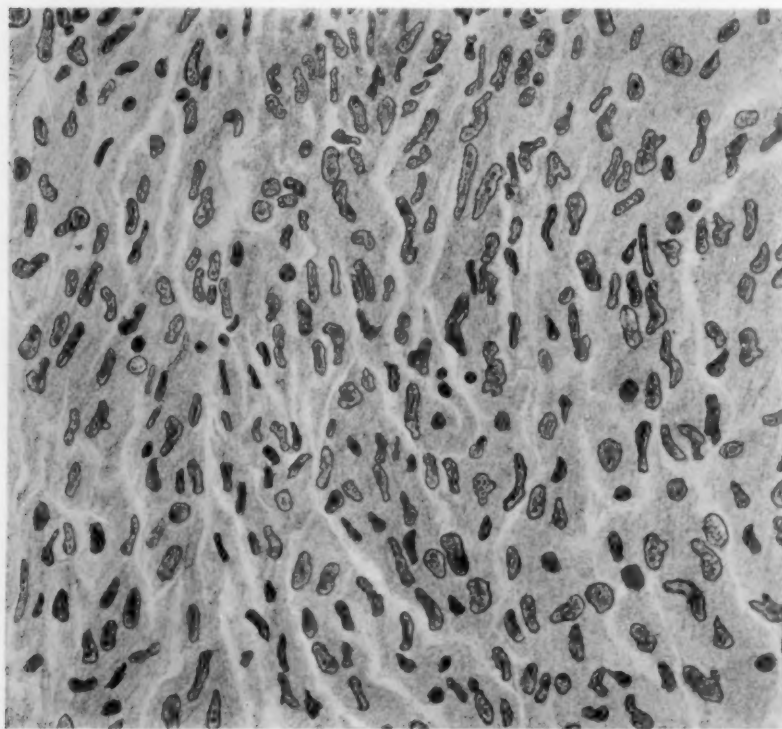


FIG. 1.—Drawing showing a typical section of sarcoma of omentum.

cells. Stool examination negative. Stomach analysis, fasting content of 200 c.c. of bile-stained fluid with a deficit of free HCl. Gastro-intestinal X-ray examination showed a large intra-abdominal, extra-alimentary mass with ascites.

An exploratory laparotomy was made by Dr. E. A. Graham. The abdomen was opened by a left upper rectus incision, allowing to escape a large amount of bloody fluid. A tumor was found lying beneath the stomach. Many adhesions were present and the viscera were swollen and oedematous. In order to inspect the mass better, an opening was made through the mesocolon. There escaped through this opening a large amount of old blood, followed by fresh blood. About 1500 c.c. of fluid escaped. Because of this fluid, a satisfactory inspection or removal of tissue for diagnosis could not be done. The cavity was packed with gauze and the abdomen closed about it.

Post-operatively the patient was given a transfusion of 700 c.c. of blood.

## SARCOMA OF THE OMENTUM

Following the operation he improved and for a time was able to be up in a wheel chair. He soon became weaker, however, developed pulmonary symptoms without chest findings, and died two months after admission to the hospital.

Autopsy No. 1883, by Dr. Hiram Liggett. On opening the abdomen a large new growth was encountered filling the entire upper abdominal cavity, displacing the intestinal coils downward and the liver to the right and upward. The bulk of the tumor lay on the left side. The tumor mass was yellow in color, convoluted and was covered with many blood-vessels. It resembled a normal brain surface and was of soft consistency. The upper part of the tumor covered the stomach and spleen. Low down on the anterior surface of the mass were folds of the great omentum. The lesser peritoneal cavity was obliterated. Mesocolon normal. Posteriorly the tumor was found to bear the same relations to the great omentum as it did in front, *i.e.*, lying within its folds shortly after it left the greater curvature of the stomach. The tumor mass was very vascular and there was extensive necrosis present. The liver lay in contact with the tumor and in the left lobe there was an accumulation of metastatic nodules. Stomach, pancreas, spleen, kidneys and adrenals free from tumor. The left-sided position of the tumor and the appearance of the liver were against the hepatic origin of the new growth.

Microscopic study of several sections of the primary growth show it to be made up of a mass of cells with large, oval nuclei, containing mitotic occasional figures (Fig. 1). The cytoplasm in most cells is inconspicuous and fine fibres run between the poles of adjacent cells. The cells are of uniform shape and character with a fascicular arrangement. The sections show many blood-vessels and some necrotic areas surrounded by infiltration of polymorphonuclear cells. Sections through the secondary tumors of the liver show tissue identical with that of the primary growth. Mediastinal, retroperitoneal and mesenteric lymph-glands do not show involvement with tumor.

Diagnosis made of spindle-cell sarcoma of the great omentum with invasion of the liver.

From a study of the reported cases, primary sarcomata of the omentum are found to occur more commonly in females than males. Most of the cases have been in the white race and between the years of thirty-one and sixty. The symptoms and signs vary widely and usually give no clew to the true pathology. Most cases have had a latent period with symptoms suggesting gastro-intestinal disease, as intestinal obstruction, cancer of the stomach, etc. Accompanying the slow onset there is a loss of weight, abdominal pain and constipation which may alternate with diarrhoea. When the tumor becomes palpable there is usually associated ascites, distention and the progress of the disease becomes rapid. The anæmia and cachexia are usually not marked.

Tumors of the omentum attain great size and they are movable early in their course. A primary sarcoma of the great omentum was found in the sac of a left scrotal hernia. Metastases are uncommon and direct invasion is not widespread. All varieties of sarcoma have been found in the omentum, but the spindle-cell type has been the most common. Cystic tumors of the omentum may be confused with cysts of the pancreas, liver, ovaries, urachus and mesentery. Solid tumors of the omentum have been difficult to diagnose before operation.



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## CONGENITAL DIAPHRAGMATIC HERNIA

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AND

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UNTIL the advent of radiography diaphragmatic herniæ were very infrequently recognized during life; but of late this condition has been noted more frequently by this means of examination and more cases are being recorded in the literature. Siebert, in his review of the literature of this subject in 1916, had found 252 cases. Since that time a number of cases have been reported by various authors. In the cases noted by far the larger number were the result of trauma; those of congenital origin are relatively few. The following case is of interest in this respect:

*Case Report.*—The patient, O. P., a young female was admitted to the surgical service of Doctor Connors at Harlem Hospital with the following history: About 6 P.M. on the day of admission, October 9, 1922 patient fell while roller skating, striking the back of her head. She did not lose consciousness, she became dizzy and was unable to walk unassisted. She was admitted with a tentative diagnosis of a fractured skull.

Previous history which was obtained from the mother was as follows: Has had the usual diseases of childhood. For the past three years the child has suffered from a gastric disturbance which has become progressively worse, so that for the last year and a half the patient has had to lie down for an hour after each meal, to relieve the discomfort.

Physical examination revealed a normally developed female about thirteen years old, not acutely ill. No loss of muscular power and fully conscious, complaining of headache which is confined to the occipital region.

*Physical examination* revealed eyes, ears, nose and throat negative. Cervical glands slightly enlarged. The chest showed slight bulging of left side posteriorly. The circumference at the level of the angle of scapula at inspiration is  $74\frac{1}{2}$  cm. and at expiration is 70 cm. Left side at median, inspiration is  $37\frac{1}{2}$  cm. and the right side is  $34\frac{1}{2}$  cm. Percussion on the left side reveals moderate dullness over the lower lobe posteriorly and anteriorly, except over the normal area of cardiac dullness which in this case is tympanitic. There is diminution of respiratory murmur all over the left chest.

The area of normal cardiac dullness on left side is replaced by tympany. After patient drinks one pint of water this area becomes dull to percussion. Cardiac impulse is felt more strongly on the right side. Apex is apparently over the fifth rib on right side  $4\frac{1}{2}$  cm. from mid-sternal line. No thrills noted. The heart percusses on right side from the 3rd rib to the 5th rib and extends outward  $7\frac{1}{2}$  cm. from the median line. The sounds are heard more distinctly on the right side and most distinctly over point of maximum cardiac thrust, 5th rib,  $4\frac{1}{2}$  cm. from mid-sternal line. The sounds are of good muscular quality. Second sound is accentuated over third space to right of sternum. No murmurs detected.

Examination of abdomen reveals an area of tympany in right upper quadrant

# CONNORS AND ROBINSON

corresponding to stomach. After drinking one pint of water this area becomes dull. Mass felt in right side extending from hypochondriac region to a point  $3\frac{1}{2}$  cm. below umbilicus and practically filling up right side of abdomen. Ex-

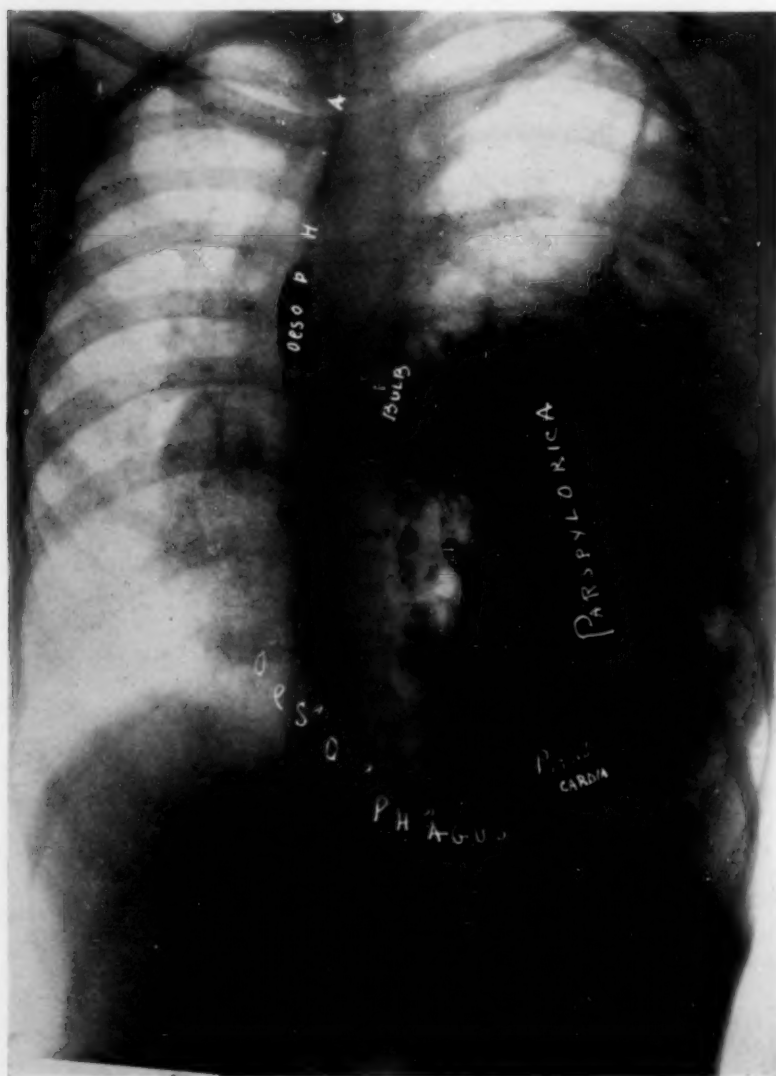


FIG. 1.—The esophagus, stomach and duodenum outlined. Note relation of the stomach. The pars cardia occupies a lower position than the pars media.

tremities and reflexes normal. Urine examination is negative. Blood count: Red blood-cells 4,600,000; hæmoglobin 85 per cent.; white blood-cells 6,400; Polymorphonuclears 60 per cent. Lymphocytes 40 per cent.

X-ray examination by Doctor Robinson showed no evidence of a skull fracture. The lower poles of both kidneys were found to be at the level of the transverse processes of the third lumbar vertebra, both kidneys being normal in size and shape. Fluoroscopic and radiographic examinations of the chest revealed absence of pul-

## CONGENITAL DIAPHRAGMATIC HERNIA

monary markings in the left side excepting its upper third. The diaphragmatic excursion on the right side was normal; the dome of the left side could not be distinguished. The heart is displaced to the right and partially rotated on its axis.

Examination of the œsophagus by means of the opaque mixture revealed

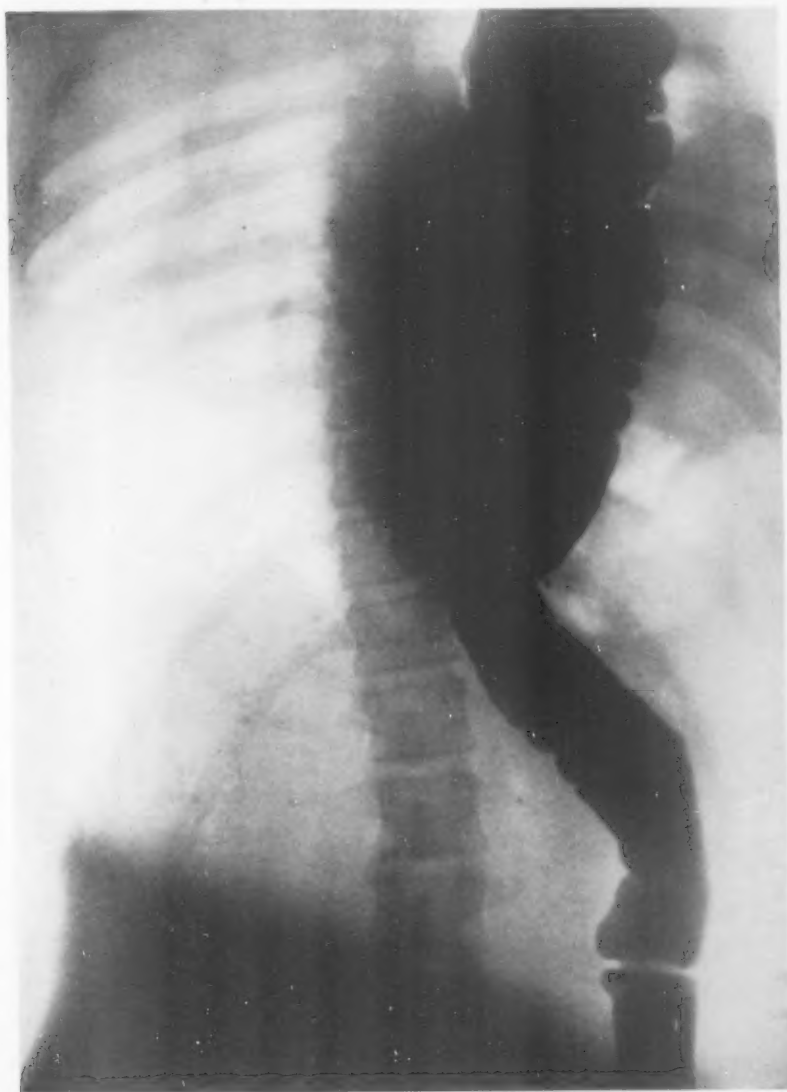


FIG. 2.—Barium enema. The upper portion of the descending colon, the splenic flexure, the transverse colon and ascending colon lie within the left chest wall.

the meal to pass down into the œsophagus and back into the thoracic cavity where it empties into the pars cardia. The stomach is also rotated on its axis so that the pars pylorica and bulbus duodeni are higher in position than the pars cardia (Fig. 1). When the patient is lying on her left side the pars cardia, the pars pylorica, and the bulb assume their normal relation. This

explains why the patient has to lie down for an hour after each meal to relieve discomfort. The relation of the pars cardia and the pars pylorica is probably responsible for the six-hour gastric retention. The jejunum and ileum are also in the thoracic cavity. Examination of the colon by means of barium enema reveals the rectum, sigmoid, and the lower part of the descending colon to occupy respectively the pelvic and abdominal cavities, the thoracic cavity containing the upper portion of the descending colon, splenic flexure, transverse and ascending colons and cæcum (Fig. 2). The liver is in the abdominal cavity and is also rotated on its axis, so that it lies longitudinally instead of in its usual transverse position. The left lobe of the liver is palpable at the level of the transverse process of the fourth lumbar vertebra, this having been clinically suspected of being the right kidney.

The case is reported as congenital diaphragmatic hernia, as patient had no history of injury and the gastro-intestinal disturbances date back to early childhood.



## NON-OPERATIVE TREATMENT OF DISPLACED SEMILUNAR CARTILAGES OF THE KNEE-JOINT

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It would seem as if Nature had been somewhat negligent of her work in placing in each knee-joint a couple of buffers that are so easily displaced as the semilunar cartilages seem to be in some people. Many of us have doubtless supposed that these cartilages are firmly attached by their under surfaces to the head of the tibia, and this has but deepened the mystery of their displacement. A brief review of their anatomy and physiology will be of advantage.

Situated on the head of the tibia and covering the outer two-thirds of the corresponding articular surfaces, held in place by their attachments in front and behind the spine of the tibia, and further fortified by the coronary ligaments in front, the internal lateral ligaments on the inside, and by the popliteus muscle on the outside, it would seem almost impossible for the semilunar cartilages ever to slip out of place. Concave on their upper surfaces for adaptation to the condyles of the femur so as to facilitate flexion and extension, and lined by synovial membrane, not only above, but, as some recent writers seem to have forgotten with the rest of us, also on their under surfaces as well, in order to permit rotation between them and the head of the tibia, the complexity of this joint is remarkable. Morris' description is particularly good of these cartilages: "They lessen the shock and jar of walking, running, and jumping; they fill in the intervals between the articular surfaces of the femur and tibia, which during extension are slight, but during flexion are considerable; they deepen the facets of the tibia for the condyles, and for this purpose they are less fixed at their fore part than behind, so as to be able to close in upon the spherical portions of the condyles in flexion and to slide forward and be squeezed out into large circles by the anterior, nearly flat portions of the condyles in extension. This adjustment of the fibro-cartilages to the condyles of the femur in the varying positions of the joint is due partly to their own tendency to shift, partly to their connections, and partly to the pressure and pull of surrounding parts. In flexion and extension the cartilages move with the tibia upon the femur. In supination and pronation the tibia moves upon them while they remain unaltered in their position to the femur; the outer cartilage is steadied chiefly by the pressure of the popliteus, the muscle chiefly concerned in rotating the tibia inward or pronating the leg, against the margin of the cartilage while it is acting upon the tibia."<sup>1</sup>

It is difficult to appreciate "the large circles" that the semilunar cartilages are squeezed into by extension, as well as to realize the statement of Dr. Scott

Lang that "in a perfectly sound knee the internal semilunar cartilage can be distinctly felt to recede when the knee is flexed and to come forward in extension on the antero-internal aspect of the joint." Even when all the indications point to displacement of semilunar cartilages, more often than not these cartilages cannot be felt, as in the three following cases, which were evidently due to dislocation of the internal semilunar cartilage:

*Case Reports.*—**CASE I.**—Male, twenty years old. Two years before, when jumping, he put his right knee out of joint, but kept walking about upon it although it pained him much for several weeks. Twice afterwards he sustained the same injury to it, though less severely, and he had had several "kinks" besides. Three days before being examined he had twisted it as badly as at first, and he was obliged to walk on tiptoe with knee semiflexed. The day after the accident he was told that a cartilage was out, manipulation failed to reduce it. He was discharged with the knee enveloped in cotton batting and a bandage over this, and continued to hobble as before. The pain was referred to the inner aspect of the knee, which was tender on pressure, and any attempt to extend the leg increased the pain. The tissues around the knee seemed relaxed, there was no effusion or swelling, or undue projection of the internal semilunar cartilage. Flexion caused no pain, and while the leg was reflexed I pressed firmly with my thumb over the painful spot and extended the leg quickly, and repeated this a few times, with the result of getting the leg extended. This procedure was somewhat painful, but by allowing him to rest a few minutes while using massage and then repeating the same movements of extension the pain decreased. With the heels of the hands over the natural depressions in front of the knee-joint strong pressure was made while the leg was flexed, it was then extended vigorously. After this, free and gentle passive motion was used and well tolerated. Placing a pad formed by a few folds of bandage over the inner aspect of the knee, a bandage was applied firmly over this and around the knee, and the patient walked off almost naturally with but a slight limp. In standing he could not fully extend the leg. The following day the knee was massaged and gentle passive motion employed, while exerting pressure over the inner aspect of the joint. A splint was applied to the back of the leg and thigh, but discarded as the bandage and pad alone were sufficiently comfortable and supporting. He has apparently had no return of the condition.

**CASE II.**—Miss A., nineteen years old. Ten months before while running down hill suddenly felt something slip on the inside of her right knee. The pain was momentary and she managed to walk home with difficulty. Two weeks after this it slipped again; the leg was semiflexed and could not be extended. It was kept in a splint for a fortnight and gradually straightened. It seemed well for several days, but soon slipped again while going down stairs, and she did not step with it for four weeks. An orthopaedic surgeon was consulted, who put it in a plaster case for three weeks and later in a metallic brace, which she wore only two days. After this another slip, followed by effusion, laid her up for ten days. The swelling soon disappeared. She has had several more slips since then, some of them on slight provocation, as when sitting with the lame leg partly crossed over the other below the knee and allowing it to roll outward by its own weight. She has always distinctly felt something slipping out at the inner aspect of the knee when she has made a misstep or done anything to twist the leg out. Recently she could sometimes feel it slip back. Five weeks before she came to me she stubbed her toe and had a more severe relapse than

## DISPLACED SEMILUNAR CARTILAGES

usual. She had worn a plaster case almost continually for seven or eight months, removing it occasionally indoors.

On examination I found slight peri-articular thickening on each side of the ligamentum patellæ, but no effusion in the joint. Passively rotating the leg outward caused discomfort on the inside of the knee, but inward rotation did not. Extension was normal; flexion but one-fourth normal, and on attempting to bend it further, pain was produced at the anterior aspect of the internal condyle. No undue projection of the internal semilunar cartilage could be made out. There was an apparent atrophy of disuse of the quadriceps extensor. Exercise to strengthen these muscles was instituted. The whole limb was massaged daily, more especially the muscles of the thigh; faradism was applied to the quadriceps extensor, flexion was gradually increased, while firm pressure was made over the inner aspect of the knee, and after these a bandage was firmly applied around the knee over a pad on the inside. The pad and bandage sufficed to give the leg a feeling of security and allowed more freedom of motion than anything that had been applied. In four days the leg could be bent to a right angle. In order to improve the flexion she was told to support herself and get into a squatting position three or four times a day. To prevent a repetition of her accident she was advised to walk with the knee extended and toes turned out. Two months later she reports having regained practically normal function.

CASE III.—Mr. C. E., fifty-two years old. Three weeks before his right foot caught in a croquet wicket and he hurt his knee. It was semiflexed and painful, and attempts to straighten it were not successful. His physician did it up in plaster-of-Paris for three or four days, and after that he hobbled about with it partly flexed. Slight, unexpected eversion of his foot had often thrown something out at the inside of his right knee, and this had frequently occurred in bed. But he had always been able to twist and extend the leg himself in such a way that he could feel it slip back again, until this last time. The knee had bothered him in this way for ten years.

On examination there were found slight effusion and heat and some peri-articular thickening, and the muscles on the front of the thigh were soft and flabby. No projecting cartilage could be felt. Massage and snug bandaging were given with a pad over the inside of the knee, passive motion with firm pressure over the seat of the internal semilunar cartilage every day for a few days, and later every other day, with home exercises of extension and flexion. In two weeks he had good use of the knee and could go up and down stairs and in two weeks more he had resumed riding his bicycle.

The increased comfort and support of a bandage with a pad under it, in comparison with the discomfort and lack of support of splints and plaster cases, is surprising.

The following case is narrated by Dr. W. H. Bennett:

CASE IV.—A soldier had a displacement of the internal semilunar cartilage which was replaced soon after the injury. The ordinary exercises of the gymnasium were at once prescribed. At the end of a week the displacement recurred, pain was intense, and complete extension impossible. Reduction was attempted, but without success. The exercises were continued and as much walking as possible allowed. Six weeks later the leg was still flexed and could not be extended by manipulation, the knee was distended and pain on walking acute. Rest for a fortnight and massage without exercise removed the fluid, and reduction occurred spontaneously while turning in bed; but recurrent attacks followed until he was operated upon and a piece of the semilunar cartilage removed.

Text-books on surgery are woefully deficient in information concerning displacement of semilunar cartilages. The best monographs on the subject are by Dr. Scott Lang and Dr. Herbert W. Allingham, and from these we learn that the semilunar cartilages may slip forward, backward, inward or outward. The internal semilunar cartilage is the one most often at fault. As to the symptoms in general, the knee is usually semiflexed and can not be extended; but flexion is usually free in recent cases. The foot is turned outward when the internal semilunar cartilage is displaced; inward when it is the external semilunar cartilage. In most cases little or nothing abnormal can be seen or felt about the joint, except the semiflexion and a little tenderness at the head of the tibia. Rarely can the cartilage be felt projecting, and even when it does synovitis may supervene in a few hours and mask it.

*Etiology.*—Though any violent accident may produce internal derangement of the knee-joint, most cases would probably coincide with Doctor Knott's instructive description of his own case: "It has always been the result of a very slight, and in every instance, an indirect violence. This violence has always been applied so as to produce a twist at the knee, either of the leg outward or of the femur inward. The most common cause has been striking the inside of the great toe against something when the knee has been slightly flexed, the parts about the joint as relaxed as possible, and the muscles thrown off their guard. I never suffered any derangement when the limb was in a decided state of active motion."<sup>2</sup>

The whole subject has been still further elucidated by Dr. Scott Lang,<sup>3</sup> who points out that the internal semilunar cartilage is displaced in rotation of the leg outward combined with flexion, and external semilunar cartilage in rotation of the leg inward combined with flexion, and that the injury is caused by some sudden and almost involuntary movement when the muscles governing the joint are off their guard or fail to act in concert with one another. A lax condition of the ligaments and muscles of the knee-joint from general debility or previous synovitis would predispose to these accidents.

*Treatment.*—Laying aside cases that require surgical interference by cutting into the joint, the indications for treatment must be very clear. Restore the cartilage to its natural position if possible. Retain it there. Strengthen the joint and muscles so that they will be less likely to be caught off guard. Various suggestions are made as to the methods to be pursued to replace the semilunar cartilage. When one fails another is tried. The method that seems to be most reliable is as follows: Flex the leg as much as possible upon the thigh, then rotate the tibia inward if the inner cartilage is displaced, outward if the external, and extend the leg quickly upon the thigh while pressing with the thumb where the cartilage is supposed to be out of place. The opposite procedure, extension, then flexion with pressure, sometimes succeeds. As it may be very difficult to ascertain whether a cartilage has slipped out of place or not, Dr. Samuel J. Mixter has made the very shrewd suggestion "that in every case of sprain or twist of the knee, movements of replacing a dislocated meniscus should be ordered;" but if a semi-

## DISPLACED SEMILUNAR CARTILAGES

lunar cartilage is not displaced, it is very evident that such a procedure would hurt the patient unnecessarily and be very likely to aggravate a sprain of this joint, and if a semilunar cartilage were not displaced, such movements might put it out in a sprained knee.

Concerning this point Dr. William H. Bennett says that repeated futile attempts at replacing the structure which is supposed to be displaced have been the cause of some of the worst cases of traumatic arthritis of the knee-joint with which he has had to deal, and in two led to the development of tuberculous disease. Temporary fixation and massage he considers of the utmost importance for the removal of the fluid from the joint and to allow the loose portion of the cartilage to fall back and adhere in its normal situation, which with the help of the surrounding inflammation often follows to some extent. Massage of the muscles and of the joint without motion can not be begun too soon, for it prevents the wasting of the muscles and the flaccidity of the capsule. Passive motion without rotation should soon follow, as it prevents adhesions; but passive or active motion involving rotation should not be encouraged in the early stages.

It does not seem to me that a hamsplint or a plaster case is so direct and effectual in retaining a semilunar cartilage and supporting the knee as a pad with a snug bandage over all. Moreover, there would seem, in some cases, at least, to be a tendency of these cartilages to slip back into place even when attempts to readjust them had failed, but if the joint is immovably fixed by a hamsplint or plaster case, its power to adapt itself to a return of the cartilage by unconscious motion is prevented, which is not the case with a pad and bandage. For the relief of the heat, pain and swelling that result from a sprain, wrench, or twist, massage properly applied is most satisfactory. For the preservation of the circulation and nutrition of the muscles and the prevention of atrophy, massage applied early has proved to be quite effectual.

As displacements of the semilunar cartilages are most likely to occur when the muscles are off guard, our endeavors should be to strengthen these muscles so that they will not be "caught napping." I imagine that the behavior of muscles in this manner is due in great measure to a loss of muscular sense, the restoration of which is promoted greatly by means of massage, and this will be still further aided by alternating massage with carefully graduated movements of pushing and pulling, and of voluntary efforts of holding the leg extended. A few minutes' application of the faradic current to the quadriceps extensors immediately after the massage sometimes seems to have a more invigorating effect than either alone, and, moreover, the contractions caused by the faradic current are but another and useful form of motion.

Walking with the foot turned inward is considered to be a good precautionary measure when the internal semilunar cartilage is liable to slip out of place, with the foot turned out when the external cartilage is likely to slip, but as either of these positions allows all the more latitude for rotation in the opposite direction when the knee is semiflexed, it can only be safe so long as the patient receives no violence to throw the leg in the opposite



direction; whereas, if the patient walks with the foot turned out and knee extended, where it is a question of preventing dislocation of the internal semilunar cartilage, then, as it is already in the position where the cartilage is liable to be displaced, but with the muscles on guard, unexpected violence is resisted, and the range of motion that would be dangerous is reduced to a minimum, as was the case with the second patient reported.

In cases that have required operation for the removal of the semilunar cartilages or for stitching them in place, the joint is generally stiff for some time afterwards. As soon as two or three weeks after the operation Doctor Allingham recommends daily massage and passive motion, and later that the patient should try to sit on his heels, assisted by holding on to something, so as to graduate and control the weight upon the knee.

Full of significance are the following words of Dr. A. Logan Turner<sup>4</sup>: "In order to gain some idea as to how soon after operation a man may return to his work, one must take into consideration the nature of the operation, the length of time during which splints have been worn, and the amount of care which the patient gives to massage and movement."

It is important to learn that some good surgeons like Dr. A. N. McGregor, of Glasgow, consider that the passive motion and massage in these cases may be commenced on the removal of the sutures at the sixth to the tenth day, or, if much swelling of the joint has occurred, they may be delayed to the fourteenth day.

In about three weeks the patient should be able to walk about with the aid of a stick, and some of his patients have been able to work in six weeks from the date of the operation.<sup>5</sup>

*Conclusions.*—1. That neither in their natural or unnatural position can semilunar cartilages often be distinguished from the surrounding tissues. They seem to form an inseparable part of the head of the tibia.

2. That the position of the leg affords the best means of inferring whether one or the other semilunar cartilage may have been dislocated when it cannot be felt, the leg being usually flexed and the foot turned out when the internal meniscus is dislocated, the leg flexed and the foot turned in when it is the external.

3. To attempt to replace a dislocated semilunar cartilage it is wise to flex the leg, then extend suddenly, rotating the leg inward if it be the internal cartilage, outward if it be the external, while exerting pressure over the offending region.

4. That there is a natural tendency in some cases of dislocated semilunar cartilages to slip back into place when the leg is not artificially restrained.

5. That if the knee be immovably fixed by plaster or splints before the cartilage has got back into its natural situation, the joint is locked and restrained from gentle instinctive movements that might favor its return.

6. That cases of displaced cartilage are attended by voluntary and involuntary restraint of motion on account of pain and mechanical impediment, and in some cases by synovitis and the formation of adhesions. Forcible passive

## DISPLACED SEMILUNAR CARTILAGES

motion might then have the double purpose of breaking the adhesions and rectifying the displacement.

7. That even after a meniscus has been restored to its natural situation it is not so securely and comfortably held by plaster and splints as by a pad of a few folds of bandage and a figure-of-eight bandage applied over this, which affords support and comfort and a safe limit of motion.

8. That it is possible by carefully applied massage, resistive movements, exercises, and electricity, to so strengthen the muscles on the front of the thigh, the fascia, ligaments, and attachments of the knee-joint, that they will safely hold a previously dislocated semilunar cartilage without artificial support.

9. These remarks do not apply to cases requiring surgical operation, though the above-mentioned combination of treatment might be safely tried in some cases before cutting into a knee-joint, but more especially after operation for restoring motion and strength.

Closely allied in symptoms to unstable semilunar cartilages of the knee-joint are thickened fringes and hypertrophied synovial villi. In a few patients who have recently come to me for treatment and were patiently and hopefully waiting for operation as a last resort, the kinks, the catches, and the synovitis have rapidly disappeared under massage and tight bandaging, and the joints have resumed their normal shape and function. This might be explained by the squeezing of the exudation out of these fringes and pushing them up into the intercondyloid notch where they would not be liable to be pinched between the condyles of the femur and the head of the tibia.

## REFERENCES

<sup>1</sup> Henry Morris: *Anatomy of Joints*, London.

<sup>2</sup> Doctor Knott: *Dublin Quarterly Review*, 1882, p. 489.

<sup>3</sup> Scott Lang: *Edinburgh Medical Journal*, 1886-87.

<sup>4</sup> A. Logan Turner: *Internal Derangement of the Knee-joint*, *Edinburgh Hospital Reports*, vol. ii, 1894.

<sup>5</sup> A. N. McGregor: *International Clinics*, 1908.

## FRACTURES OF THE FEMUR IN CHILDREN\*

TREATMENT AND END RESULTS IN 268 CASES

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THIS report comprises cases of fractures of the femur in children up to the age of thirteen years. It incorporates two groups of cases; the first, sixty-seven fractures that were admitted to the service from January, 1916, to July, 1917. The second series of two hundred and one fractures that were admitted from October, 1919, to October, 1922. We have not included

fractures of the femur associated with serious injury to other regions of the body which resulted in death shortly after admission.

The report will emphasize the conservative line of treatment, the course followed and the observations made in the hospital and return clinic.

The majority of cases in which the anatomical approximation of the fracture was not satisfactory have been followed

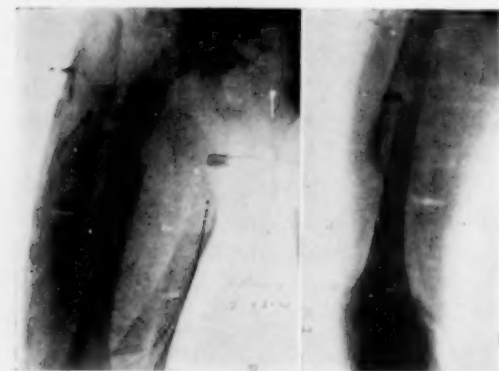


FIG. 1a.—J. F., five years. Oblique fracture, upper third, treated in Bryant's frame. Discharged with  $1\frac{1}{2}$  cm. shortening.

for a period of six months to three years. The clinical course has shown that perfect anatomical reduction is not essential for perfect functional recovery in children. Marked displacement and over-riding of the fragments will usually result in a good functional limb, without appreciable deformity, tilting of the pelvis or compensatory curvature of the spine. It will also demonstrate that shortening, which existed on discharge from the hospital, was not always permanent, and in a number of cases where shortening existed at the time of discharge subsequently presented an appreciable lengthening within a year or two. This lengthening was frequently present when operative intervention had been resorted to in the reduction of the over-riding fragments. The lengthening was not due to over-correction of the over-riding with the exception of two cases in which calipers were inserted.

The stimulation of the growth of bone in its longitudinal direction occurred in the fractures of the diaphysis irrespective of their location in the shaft; in

\* Read before the New York Surgical Society, March 14, 1923.

## FRACTURES OF THE FEMUR IN CHILDREN

no case was there any involvement of the epiphysis when subsequent lengthening ensued. In the cases of extreme shortening no disability resulted, the shortening being compensated for by slight tilting of the pelvis, which was difficult to detect.

Ashhurst states that "Surgeons often make a mistake in very young children in regarding bones as things separate from soft parts; the bones were originally formed out of soft parts and the younger the patient the more intimate is the physiological connection between the two. The bones depend for their form on the action of the muscles and in the daily use of the limb, almost any deformity of the shaft of a long bone in a young child will be spontaneously corrected within six months or a year."

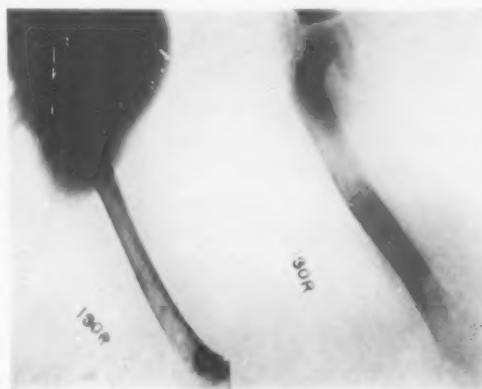


FIG. 1b.—Final result, two and one-half years later, no shortening.

*Age.*—The youngest was an infant which had sustained a birth fracture and had been transferred from the maternity service on the fifth day. The greater number of fractures occurred during the third, fourth, fifth, sixth, and seventh year. The comparative frequency of fractures in the various ages are enumerated in Table I.

TABLE I

5 days .....	1	3 years .....	27	8 years .....	20
2 months .....	1	4 years .....	26	9 years .....	21
6 months .....	3	5 years .....	39	10 years .....	16
1 year .....	14	6 years .....	35	11 years .....	12
2 years .....	15	7 years .....	33	12 years .....	5
Total .....					268

*Type of Fracture.*—There were two hundred and sixty-one simple fractures and seven compounded.

The most common type of fracture was the oblique, which with the spiral comprised 55 per cent. of all fractured femurs (Fig. 1), 35 per cent. were transverse (Figs. 2 and 3), and 3 per cent. comminuted (Fig. 4), two were pathological, one following an acute osteomyelitis of the femur and the other in a case of achondroplasia.

*Location of Fracture.*—There were only two fractures of the neck of the femur, both caused by direct violence. For the convenience of classification most of the fractures were grouped into upper, middle, and lower third. Sixty-four per cent. occurred in the middle third, 20 per cent. in the upper third and 9 per cent. involved the lower third. There were five supracondylar

and six of the lower epiphysis. Five children sustained fractures of both femurs.

TABLE II

Head .....	0	Lesser trochanter ...	0	Lower third .....	28
Neck .....	2	Upper third .....	56	Supracondylar .....	5
Great trochanter .....	0	Middle third .....	171	Lower epiphysis.....	6
Total .....					268

*Displacements of Fragments.*—The records of the first series of cases were not complete enough to give the displacement of all fragments, consequently the statistics on displacement of fragments are drawn from the second series of two hundred and one fractures.

In fractures of the upper third the upper fragment was displaced internally and posteriorly nearly as frequently as the more commonly accepted displacement of flexion and abduction. In the middle third the more frequent displacement of the upper fragment was internal and anterior, while in the lower third the upper fragment was usually displaced externally. A detailed report of the displacement of both fragments is given in Table III.

TABLE III

	Upper Fragments			Lower Fragments		
	Upper 3rd	Middle 3rd	Lower 3rd	Upper 3rd	Middle 3rd	Lower 3rd
No displacement .....	6	20	5	6	20	5
Posterior .....	2	8	0	7	29	1
Internal .....	10	37	1	9	20	1
External .....	13	31	6	9	24	1
Anterior .....	5	22	1	2	8	0
Inward and backward ....	0	0	0	6	11	3
Outward and anterior ....	3	8	0	0	6	0
Outward and backward....	1	1	0	3	9	1
Inward and anterior.....	4	5	1	2	5	2
No record .....		1	..	..	1	..
	44	133	14	44	133	14

## SUPRACONDYLAR FRACTURES

	Upper Fragment	Lower Fragment
No displacement .....	3	3
Posterior .....	1	1
Anterior .....	1	1
	5	5

*Treatment.*—The various methods of treatment have been grouped into non-operative and operative as indicated in Table IV.

In the endeavor to make the treatment uniform and readily applicable to as many cases as possible, all the readily available procedures were given a satisfactory trial in standardizing the treatment on the service. It was found that the more simple the apparatus which would not hinder careful observation and nursing, and which served as a permanent appliance from



## FRACTURES OF THE FEMUR IN CHILDREN

the inception of the treatment, was the most desirable, even though a longer time elapsed before functional recovery was obtained.

Irrespective of the method of treatment employed in the reduction and fixation of the fragments, the preliminary procedures pursued were the same and are worthy of mention.

On admission to the dressing room, the nature of the fracture, deformity and shortening are recorded and the limb is fluoroscoped. A towel is placed around the ankle in the form of a loop and a rope is attached from which traction of ten to fifteen pounds is immediately made over the foot of the stretcher. This procedure relieves the patient of considerable pain caused by the fragments pressing against the



FIG. 2a.—S., four years. Transverse fracture middle third. Treated in Bryant's frame. Discharged with  $\frac{1}{2}$  cm. shortening.

soft structures, overcomes muscular spasm, prevents further over-riding and facilitates subsequent reduction.

All fractures of the femur are treated as emergency cases and a member of the Attending Staff is required to be present. Unless some serious trauma to another region of the body contraindicates the administration of an anæsthetic and manipulation, the patient is anæsthetized, and if the fracture is transverse an attempt is made to reduce and lock the fragments. Moleskin or zinc oxide plaster is applied in all cases even if we feel the fragments have been satisfactorily reduced and locked.

Children up to the age of six are then suspended in a Bryant frame (Fig. 5). This form of treatment may be employed for older children, but should not be encouraged, as the great weight of the body will frequently tear off the extension straps, permitting sagging of the fragments and requiring its frequent reapplication.

The type of frame we have adopted consists of two uprights about five feet long slotted in four places to permit the cross-bar and pulleys, fastened



FIG. 2b.—Final result ten months later, no shortening.

to the upper ends of the uprights, to be adjusted to any desired height. A horizontal bar, to which two pulleys are attached, is fastened to the back of the head of the crib.\* The uprights have been made of sufficient length to permit raising the buttocks for a bedpan or the changing of linen without the feet coming in contact with the suspension bar, which would allow sagging of the extremities.

If it has been possible to lock the fragments or if there is not much over-riding, both legs are suspended with sufficient weights, which exert traction

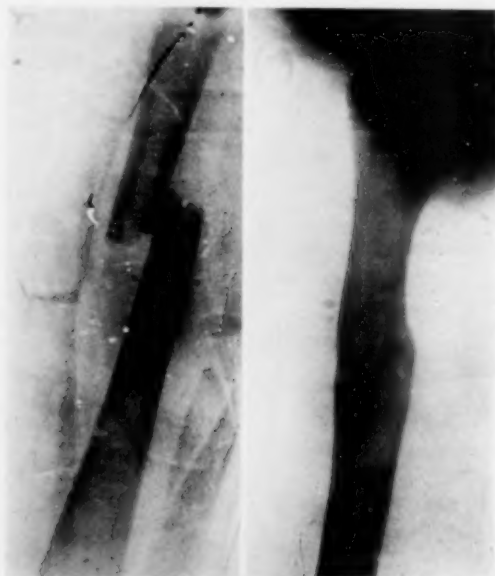


FIG. 3.—J. McG., nine years. (a) Transverse fracture, junction middle and upper third. Bryant's frame suspension. Two centimetres shortening on discharge. (b) Final result two years later.

through the pulleys at the head of the bed, to keep the buttocks about two inches off the mattress. The moleskin or adhesive has been applied from the top of the thigh as recommended by Groves, who contends that the whole tube of soft parts, skin, muscles and fascia, together with the lower fragment, will be pulled down directly over the upper fragment.

Recently in cases where there is considerable over-riding we have felt that only the fractured limb should be suspended, as we have found by numerous experiments that with only one limb suspended we get 25 to 33.3 per cent. more traction. The patients, however, are more comfortable and the nursing is simplified if both legs are suspended, but if

there is much over-riding enough traction is not exerted to overcome it. The degree of abduction or adduction of the extremities will vary with the line of fracture, the usual position being about thirty degrees abduction. The suspension is discontinued at the end of four weeks, at which time there is no limitation of motion at the ankle and but very slight limitation at the knee. The patient is kept in bed another two weeks and by that time the flexion of the knee is about normal. One of the annoying complications of this form of treatment is the fact that the adhesive extension is apt to slip gradually and unless we are constantly on the watch disagreeable pressure sores have formed over the tendo Achillis and dorsum of the foot.

Our experience leads us to believe that this form of suspension serves only as a means of immobilization and the over-riding of the fragments is not materially changed irrespective of the amount of traction employed.

## FRACTURES OF THE FEMUR IN CHILDREN

Various methods of treatment have been used for the immobilization of fractures in older children, but the most satisfactory procedure is the plaster spica with continuous extension (Fig. 6). After reducing the fragments on the Hawley table and having applied the moleskin or zinc oxide plaster traction

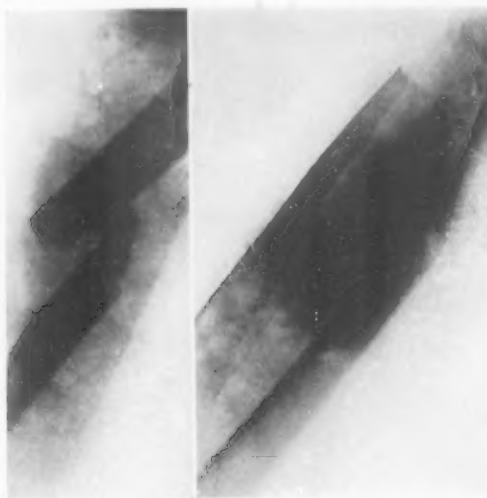


FIG. 4a.—S., ten years. Transverse comminuted fracture upper third, in case with extension. 1 cm. shortening on discharge.

straps, the femur is maintained in a position of moderate abduction by means of a plaster spica extending from the malleoli to the ribs, with continuous skin extension, ten to fifteen pounds traction being applied with the foot of the bed elevated. After the plaster spica has hardened, a subsequent radiograph is taken in bed to ascertain if the reduction has been satisfactory. No further treatment will be required until the removal of the cast at the end of six weeks. The results from this method have been so uniformly satisfactory that this procedure has been adopted as a routine. There is no limitation in motion of the hip-joint, the disability at the knee is only temporary, and before another month has elapsed there is a complete range of motion at the knee unless there is some associated condition limiting flexion. Passive and active exercises are instituted and the patient is allowed out of bed in two weeks on a prone board and crutches, the latter being discarded at the end of another two weeks.

The maintenance of continuous skin traction is used not with the idea of improving what over-riding may exist after reduction, but to attempt to prevent any change in the relative position of the fragments.

*Suspension Treatment.*—As indicated in Table IV, several cases were treated by suspension with the Thomas or Hodgen splint, to observe the efficacy of this method in children between seven and twelve years of age. The children would toss about and tilt the splint to the sides, the rings were either too small or too large, occasionally the ring would become moist or the skin

After the plaster spica has hardened, a subsequent radiograph is taken in bed to ascertain if the reduction has been satisfactory. No further treatment will be required until the removal of the cast at the end of six weeks. The results from this method have been so uniformly satisfactory that this procedure has been adopted as a

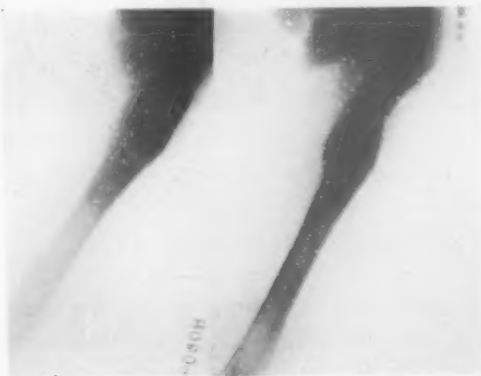


FIG. 4b.—Final result, eight months later no shortening.

traction would slowly slip down over the heel and malleoli, producing a sloughing of the skin unless carefully guarded against. In cases where the knee was flexed and the extension made only on the thigh, the constant wriggling of the patient, who only occasionally coöperated, would frequently tear off the skin traction. This method requires constant vigilance and care, and the advantage claimed, in that active and passive motions are begun at the outset with consequent earlier functional recovery, does not warrant its use as a routine in preference to the plaster case.

There is no advantage of the Hodgen splint over the Thomas splint in children. The latter is recommended for the immobilization of the fracture

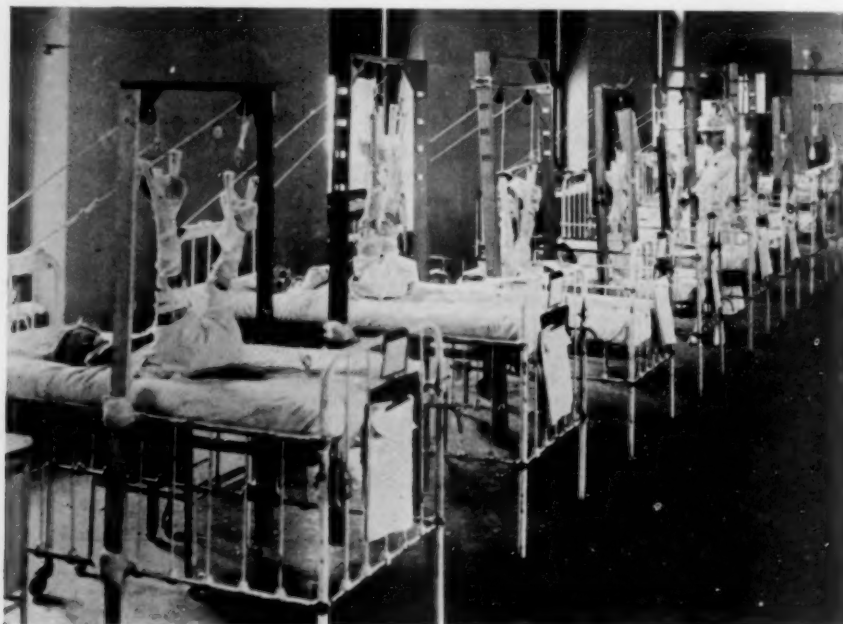


FIG. 5.—Cases in Bryant's frame with suspension.

if the condition of the patient is so serious that an anæsthetic is contra-indicated for the application of a plaster spica, in the majority of compound fractures and cases in which skeletal traction is required.

*Operative Treatment.*—In the first group of sixty-seven cases an open operation was performed in five, a percentage of 7.5 per cent., and in two a Steinman pin was inserted. In three of the open operations Lane plates were used, one was reduced after cutting down on the fragments and in the fifth the fragments were reduced and held in place by kangaroo tendon.

In the second group of two hundred and one cases open operation was resorted to in seven, a percentage of 3.5 per cent. Lane plates were inserted in three patients, three were reduced after cutting down on the fragments, and the seventh an oblique supracondylar fracture was held in position by the insertion of a wood screw. Calipers were used in five cases, four of which were suspended in a Thomas splint (Fig. 7) and one in a Bryant frame.

## FRACTURES OF THE FEMUR IN CHILDREN

Since the adoption of skeletal traction with calipers, we have not resorted to an open operation, and we feel that in children it is rarely if ever indicated. The only indication would seem to be the interposition of muscle or fascia between the fragments, and in our series we have not had a single case in which it occurred.

TABLE IV  
*Treatment*

Non-operative	
Bryant frame and suspension .....	96
Thomas splint and traction .....	14
Hodgen splint and traction .....	2
Plaster spica and traction .....	118
Hamilton side splint and traction .....	2
Operative	
Lane plating .....	6
Open reduction .....	6
Calipers .....	5
Steinman's pin .....	2
Combined Treatment	
Bryant frame and extension following use of Thomas splint.....	1
Plaster spica case and extension following the temporary application of a Thomas splint .....	6
Plaster spica case and extension changed from the Bryant frame.....	5
Plaster spica case and extension following a Hamilton S. S. and extension .....	5
	268

COMPOUND FRACTURES.—There were seven compound fractures, the majority of which were compounded from within. The earlier cases were treated in plaster with a fenestra if necessary to dress the compound wound. Recently the Thomas splint has been adopted as a routine.

### CASE REPORTS

CASE I.—B. B., seven years old; compound fracture, spiral upper third, marked outward displacement of lower fragment. Punctured wound. Case five days after admission. Subsequent X-ray showed outward displacement of lower fragment. Discharged with sinus, which persisted for several months, then child disappeared. Followed two years later, had been to private doctor, who removed sequestrum; now practically well.

CASE II.—A. B., six years old; compound fracture left femur, simple fracture right femur, slight outward displacement of upper fragment, 2.5 cm. shortening. Steinman pin inserted, later plaster spica applied. Right fracture slipped two weeks after application, marked over-riding. Lane plate inserted. Steinman pin removed in three weeks and case applied. Discharged in three months with good motion in knee-joints. Three years later right leg 1 cm. shorter than left.

CASE III.—O. G., nine years old; compound fracture of the middle of shaft of femur with backward displacement of lower fragment. There was 2.5 cm. shortening. Wound on the inner and posterior middle third of thigh. A plaster spica was applied, reinforced with iron bars to permit access to the wound, which was treated by Carrel-Dakin technic. Wound healed and a closed reduction under



## BURDICK AND SIRIS

ether was undertaken and suspended in a Thomas splint with skin traction below the site of the fracture. On discharge there was no shortening or disability. At the end of three years there was no disability or shortening.

CASE IV.—V. B., nine years old; compound oblique fracture of middle third of right femur with inward displacement of the upper fragment. Small punctured wound of the thigh about five inches below the groin. There was 1 cm. shortening. Tincture of iodine and a plaster spica case applied. The patient made an uneventful recovery. Case removed in six weeks, .5 cm. shortening on discharge, which persisted at the end of six months.

CASE V.—J. S., seven years old; compound fracture, transverse, upper third, in shock. There was a punctured wound one inch in diameter on the external

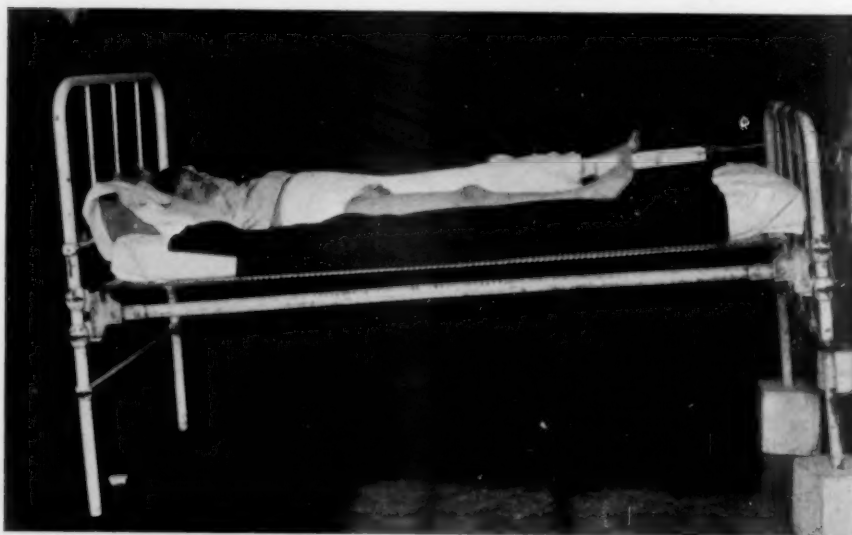


FIG. 6.—Plaster spica with extension.

surface of the left thigh, Carrel-Dakin technic; 2 cm. shortening, Thomas splint with extension applied. Six weeks later 2 cm. shortening persisted and there was some angulation at the site of fracture. On discharge there was 60 degrees flexion of the knee. After one year the 2 cm. shortening as well as the angulation was still present.

CASE VI.—D. F., five years old; compound fracture of the left femur and simple fracture of the right. Fracture of the base of the skull. Small puncture wound of the left thigh cleaned, iodized, dry dressings and suspended from a Bryant frame for four weeks. On discharge no disability, no shortening on the left side; right side .5 cm. shortening. One year later no shortening on the left side and .5 cm. on the right, no disability.

CASE VII.—E. G., five years old; supracondylar fracture with no displacement of fragments. Extensive laceration and avulsion of the skin from the upper and outer part of the left leg and knee, exposing the muscles posteriorly. Thomas splint applied and wound Dakinized. (See E. G. cases of disability on discharge not recorded.)

REFRACTURES.—There were four cases of refracture before discharge from the hospital, and none after discharge. Three were transverse and one oblique. In two of the transverse a satisfactory end-to-end reduction had

## FRACTURES OF THE FEMUR IN CHILDREN

been obtained; in the third there was a moderate inward and backward displacement of the lower fragment. Three were treated by a plaster case and extension, one in a Bryant frame. Three occurred in bed and the possibility of falling out of bed should be considered as an etiological factor. The fourth was allowed to walk too early and fell on the forty-seventh day. One was discharged with .5 cm. lengthening which increased to 1.5 cm. at the end of a year, and another was discharged with .5 cm. shortening and at the end of a year the fractured side was 1 cm. longer.

### CASE REPORTS

CASE I.—A. K., six years old; transverse fracture upper third of right femur and a transverse fracture of the lower third of the left femur. Under the fluoro-

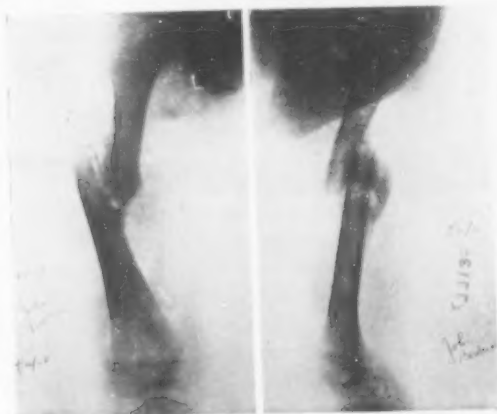


FIG. 7a.—J. B., six years. Old compound fracture, 4 cm. shortening, non-union; attempt made to break up the callus and overcome the shortening with calipers. Twenty-four hours later the old osteomyelitis became acute.



FIG. 7b.—Thigh incised, pus evacuated, ends of bone brought into apposition and held by extension with Sinclair's skate in a Thomas splint.

scope and ether the fragments were approximated and suspended by means of a Bryant frame. (X-ray on the right femur six days after first reduction revealed the fragments in good position.) The suspension was discontinued on the twenty-eighth day. Four days later the patient complained of pain in the upper third of the right femur. There was a refracture at the original site. Under ether and on the Hawley table an attempt was made to correct displacement forward and outward of the lower end of the upper fragment. The cast was kept on for twenty-eight days. On discharge from the hospital there was very slight inward and forward displacement of the upper fragment, very firm union and no shortening. One year later the condition was unchanged.

CASE II.—H. A., nine years old; transverse fracture of the upper third of the right femur; 2.5 cm. initial shortening. Under the fluoroscope and ether the fragments were approximated and the patient placed on a Hawley table while applying the plaster spica extension, which was maintained for six weeks. Two X-rays were taken one week apart and showed the fragments in perfect apposition. There was firm union on removing the case. Two days later complained of pain at the site of the original fracture. He stated he fell out of bed but this is questioned. There was a fracture at the original site. Another case was applied. There was

no shortening on discharge from the hospital nine weeks later. Six months later he left for Honolulu with a perfect functional recovery.

CASE III.—W. C., eleven years old; fracture at the base of the skull and an oblique fracture of the upper third of the left femur, with inward and backward displacement of the lower fragment. The general condition did not permit an anæsthetic on admission. A Thomas splint was applied with skin traction. Six days later on the Hawley table under general anæsthesia a plaster spica and extension was applied. The case was kept on for six weeks with apparently firm union. Five days later refractured in bed. The extremity was again placed in a spica case with extension and was removed in six weeks. The fractured side was .5 cm. longer than the other limb. On returning nine months later there was an excellent functional recovery and the fractured side was 1.5 cm. longer.

CASE IV.—M. S., eight years old; transverse fracture of the middle of the shaft of the left femur, with 2 cm. over-riding. Without an anæsthetic the case and extension were applied on a Hawley table. On the twenty-fifth day the case was removed because it was badly soiled and softened. X-ray showed a moderate inward and backward displacement of the lower fragment. On the forty-seventh day the patient slipped while walking and refractured at the same site. Under ether on the Hawley table another plaster spica with skin traction was applied for forty-two days. Home two weeks later with 90 degrees flexion at the knee and .5 cm. shortening. Year later there was a perfect functional recovery and fractured side was 1 cm. longer than other limb.

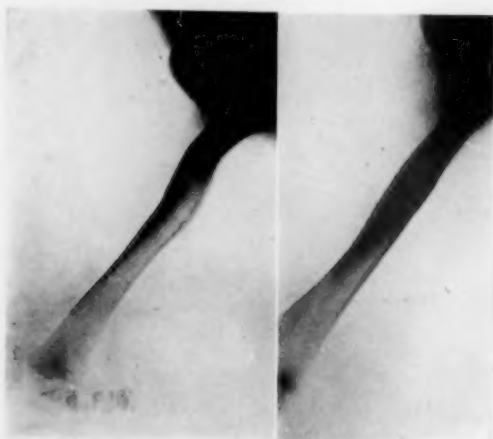


FIG. 7c.—Final result, two years later; no shortening; no evidence of osteomyelitis, perfect functional result.

*Disability Due to Lengthening on Discharge from Hospital (five cases).—*Two cases presented .5 cm. of lengthening on discharge, one of the patients, eleven years old, with an oblique fracture of the upper third was in a case for six weeks and refractured on removal of the case. A second case was applied for another six weeks and at the end of a year 1.5 cm. lengthening existed. The second was a child three years old with an oblique fracture of the middle third of the shaft, which was treated with a Bryant frame. At the end of a year both limbs were the same length.

One case eleven years old presented an oblique fracture of the middle of the shaft with marked over-riding, treated with calipers and twenty-five pounds extension for three days, then ten pounds for thirty days. On discharge there was 1 cm. lengthening, which persisted at the end of five months.

There were two cases in which there was a lengthening of 1.5 cm. on discharge. One was treated in a Thomas splint with caliper extension for thirty-two days. The lengthening has persisted for two years. The other,

## FRACTURES OF THE FEMUR IN CHILDREN

a child of ten years, with an oblique fracture of the middle of the shaft, was treated for ten days in a Thomas splint followed by a plaster case for six weeks. One year later both extremities measured the same.

*Cases Which Presented Subsequent Lengthening.*—There were fifteen cases, on discharge, in which the fractured limb was normal or shorter than the opposite side, which subsequently presented lengthening.

Seven had been treated with plaster case and extension, two in a Bryant frame, three with Lane plates, one with calipers, one was a refracture case which had been treated each time in plaster, and the last was a fracture of the neck which had been treated by the abduction method.

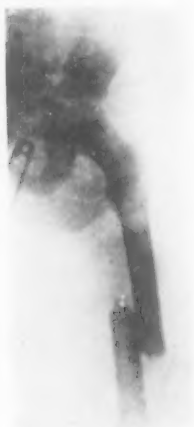


FIG. 8a.—L. C., ten years. Irregular transverse fracture middle third; fracture of the base of the skull, left hemiplegia and aphasia. Decompression treated with extension in a Hamilton's side splint for twenty-four days; 4 cm. shortening persisting.



FIG. 8b.—General condition improved; Lane plate inserted. Discharged no shortening. (Plate removed nine months later.)



FIG. 8c.—Final result, two and one-half years later, 2 cm. lengthening with anterior bowing.

### CASE REPORTS

CASE I.—L. L., six years old; transverse fracture upper third, treated by plaster spica and extension; discharged .5 cm. shortening. Returned in three years with 1.5 cm. lengthening.

CASE II.—J. F., eleven years old; transverse fracture neck of femur; plaster spica in extreme abduction; discharged, no shortening; returned in three years with 1.5 cm. lengthening.

CASE III.—J. C., ten years old; supracondylar fracture, no displacement, no shortening; plaster spica and extension; returned in three years with 1.5 cm. lengthening.

CASE IV.—W. G., five years old; spiral fracture upper third; treated with Bryant frame; discharged with no shortening; returned in two years with 1 cm. lengthening.

CASE V.—R. L., seven years old; transverse fracture middle third; Bryant frame; discharged with .5 cm. shortening, returned in two years with 1 cm. lengthening.

CASE VI.—S. E., four years old; irregular transverse fracture middle third of femur with sloughing wound of the calf muscles on the same side; treated with

calipers with knee flexed at right angles and suspended from a Bryant frame. No shortening on discharge, returned in one year with 1 cm. lengthening.

CASE VII.—M. G., six years old; oblique fracture middle third, treated with plaster spica and extension, discharged with no shortening; returned in one year with 1 cm. lengthening.

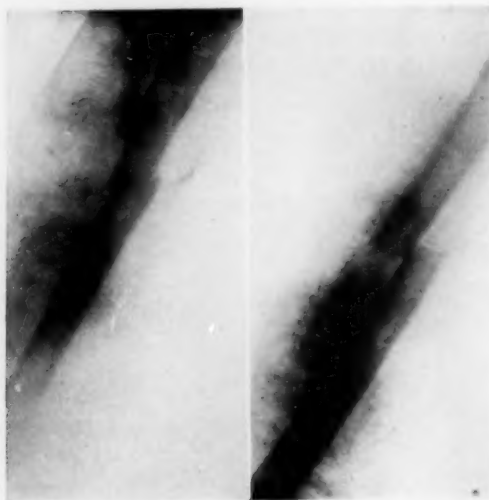


FIG. 9a.—R. B., nine years. Transverse fracture, middle and upper third. In case with extension. One-half centimetre shortening on discharge.

shortening. Returned in two years with 2 cm. lengthening. Plate removed nine months after insertion.

CASE X.—T. D., nine years old; transverse fracture middle third; treated with plaster spica case and extension; discharged with 1 cm. shortening. Returned one year with 2 cm. lengthening.

CASE XI.—D. S., nine years old; irregular transverse fracture upper third; treated with plaster case and extension; discharged no shortening; ends of fragment not in apposition. Returned eighteen months later .5 cm. lengthening.

CASE XII.—M. S., eight years old; irregular transverse fracture middle third. Plaster spica case and extension for twenty-five days (case removed because it was soiled and softened). Refractured on the forty-seventh day in hospital while walking. Case applied for thirty-one days; firm union on discharge; .5 cm. shortening. One year later there was a lengthening of 1 cm. and excellent functional recovery.

CASE XIII.—M. R., six years old; oblique fracture middle third; plaster spica and extension; discharged, no shortening; returned one year with 1.5 cm. lengthening.

CASE VIII.—L. C., ten years old; irregular transverse fracture middle third; fracture base of skull; Hamilton side splint and extension twenty-four days, 4 cm. shortening persisted; open operation, Lane plate inserted, plaster case applied; discharged with no shortening; returned in two years with 2 cm. lengthening (Fig. 8).

CASE IX.—R. W., eight years old; oblique fracture middle third; treated for twenty-one days with Hodgen splint and extension; 3.5 cm. shortening persisted; Lane plate inserted; discharged with no



FIG. 9b.—Two months later, fragments having slipped, 1 cm. shortening



## FRACTURES OF THE FEMUR IN CHILDREN

CASE XIV.—J. B., nine years old; transverse fracture upper third; 3 cm. shortening, plated; returned one year later with 1.5 cm. lengthening.

CASE XV.—M. R., six years old; transverse fracture upper third; 2 cm. shortening; case applied; eighteen months later 1 cm. lengthening.

*Disability Due to Shortening on Discharge.*—One hundred and thirty-two cases presented no shortening on discharge, five were discharged in cases, and in eight no mention was made on the history as to shortening.

In sixty-six cases a shortening of .5 cm. existed on discharge. At the end of a year thirty-seven of these showed no shortening, and in fourteen it still persisted. In two cases at the end of two years there was an appreciable lengthening of the fractured limb. In one patient the shortening had increased to 1 cm. at the end of three months, which persisted at the end of one year, due to the fractured ends having slipped, probably because the callus was not sufficiently firm when the child was allowed to bear weight on the limb (Fig. 9). In this case walking calipers would have been indicated. Three cases failed to return to the follow-up clinic. Nine were followed less than a year and during that time showed no change.

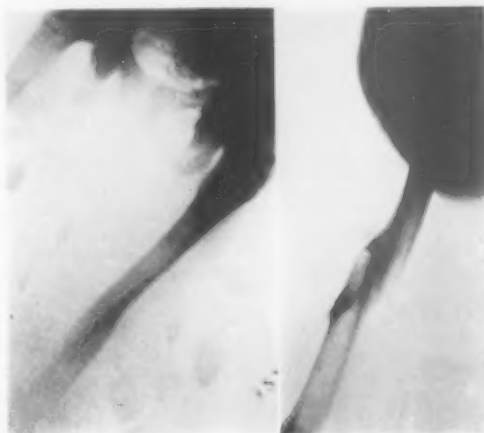


FIG. 9c.—Final result ten months after injury: 1 cm. shortening persisting.

There were thirty-four cases in which 1 cm. shortening existed on discharge. At the end of a year eleven were normal, in nine the shortening had diminished to .5 cm. Ten showed no change. At the end of two years one of the above presented no shortening, and in another the fractured side was .5 cm. longer. Three years after injury one patient appeared with 5 cm. shortening. (Fig. 10.) This was a boy of twelve years old, admitted May, 1919, with an oblique supracondylar fracture extending into the epiphysis, with marked inward and backward displacement of the lower fragment. Several attempts at a closed reduction were made without success. An open operation was done and after reduction the fragments were held in position by a wood screw. The patient was discharged with 1 cm. shortening, complete extension and 150 degrees flexion. The following month the screw was removed. Eighteen months later the 1 cm. shortening persisted, flexion complete. Three years later there was 5 cm. shortening and a radiograph showed a premature ossification of the lower femoral epiphysis on the fractured side as the cause of the increased shortening.

Three cases were followed less than a year without any change.

There were ten cases with 1.5 cm. shortening on discharge. At the end

of one year there was no shortening in two cases, in three there was .5 cm. shortening, one of which was normal at the end of two years and in another case 1 cm. shortening. In four the shortening persisted at the end of one year.

There were five cases presenting 2 cm. shortening on discharge; two of these patients moved to other states and were not followed. Of the three followed, one showed only .5 cm. shortening at the end of one year, the second showed 1.5 cm. shortening, and in the third the 2 cm. shortening persisted.

Two patients had 2.5 cm. shortening. At the end of one year one had 1 cm. shortening and the other 1.5 cm. shortening.

There was one case in which 3 cm. shortening existed on discharge from the hospital. This

FIG. 10a.—B. F., thirteen years. Supracondylar fracture extending into the epiphysis with inward and posterior displacement of the upper fragment. Several unsuccessful attempts made at closed reduction.

was a child eleven years old who was a spastic paralytic and had never walked. Her condition was such as to contraindicate an anæsthetic and she was treated in a Hodgen splint with extension.

*Summary.*—Of the one hundred and eighteen cases presenting shortening on discharge from the hospital, fifty-three became normal within a period of one to three years, in fourteen the shortening was diminishing, forty-one showed no change, but the majority of these were followed for less than one year, two showed an increasing shortening and five could not be followed.

*Disability Due to Causes Other Than Shortening and Lengthening of Two Hundred and One Cases of the Second Series.*—Records of the first

group were not sufficiently complete to tabulate. One hundred and four cases had no other disability on discharge.

In twenty-seven cases there was a limitation of flexion of the knee within the range of 110 to 155 degrees. At the end of three months there was no disability in twenty-five of these cases. In one flexion was still limited to 110 degrees. This was a child with rickets and at the end of a year the

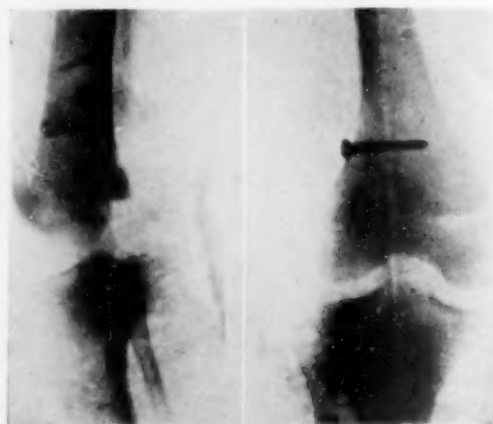


FIG. 10b.—Open operation. Fragments held in position with wood screw. Discharged with 1 cm. shortening.

## FRACTURES OF THE FEMUR IN CHILDREN

disability had disappeared. In the other case there was a suppurative process in the region of the knee which persisted for over three months and then became normal.

In thirty-one cases flexion of the knee was limited to ninety degrees. This disability had entirely disappeared in all these cases at the end of three months.

In twenty cases the flexion of the knee was less than ninety degrees. Sixteen of these had complete functional recovery within three months. Two failed to return. One had ninety degrees flexion at the end of three months and within a year there was a complete return of function, this disability was due to an accompanying osteomyelitis of the fibula on the same side, which was present on admission. The last case of this group had 110 degrees flexion at the end of three months and complete functional recovery at the end of a year. This was a re-fracture case and was kept in plaster twelve weeks.

There were three cases of outward rotation. In none was it more than twenty degrees. At the end of one year it had disappeared in two cases and in the third it persisted. This was a boy seven years old with an oblique fracture of the upper third. He had tuberculosis of the spine.

There was one case of bowing at the site of fracture which persisted for two years, a Lane plate had been inserted and subsequently removed and the limb showed 2 cm. lengthening.

There were five cases of angulation at the site of fracture on discharge. One failed to return, one had corrected itself at the end of three months, two at the end of a year, and in the fifth the angulation was still present. This was a compound fracture which was discharged with 2 cm. shortening which also persisted at the end of one year.

Two cases showed a talipes equinus deformity. The first was associated with a sloughing wound of the calf muscles on the same side. Subsequently the tendo Achillis was lengthened and at the end of a year the function was restored. The other had an accompanying osteomyelitis of the fibula, which was present on admission. At the end of a year the talipes had entirely disappeared.

Five patients were discharged in casts and in three there was no record on the history of any disability on discharge.

End results of the five cases discharged in plaster cases:

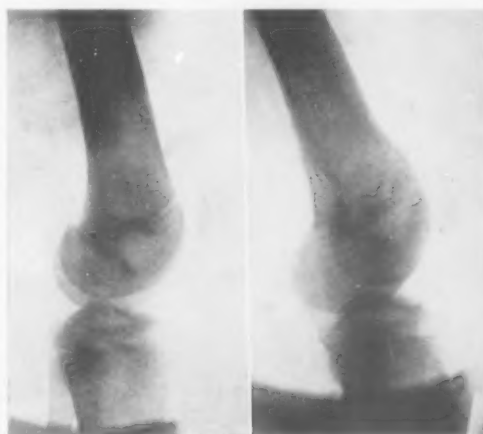


FIG. 10c.—Final result three years later. 5 cm. shortening caused by premature ossification of the epiphysis.

## BURDICK AND SIRIS

### CASE REPORTS

CASE I.—I. M., ten years old; fracture of the neck of the left femur, put in plaster spica in abduction and slight inward rotation, home at own risk on seventh day, case removed by family physician at seventh week. When seen at home by Social Worker, boy limped slightly, but walked without much disability. Refuses to return to follow up clinic.

CASE II.—M. K., four years old; supracondylar fracture of femur, plaster spica. Home at own risk on third day, case removed in six weeks. Original shortening .5 cm. Returned in three months and one year with no shortening or disability.

CASE III.—J. C., ten years old; transverse supracondylar fracture with no displacement of fragments, plaster spica. Home on sixth day, case removed at clinic at end of sixth week. At end of one year no disability or shortening. At end of two years there was 1.5 cm. lengthening.

CASE IV.—M. S., one year old; incomplete fracture of lower third of femur, light cast, home second day at own risk. At end of year no disability or shortening.

CASE V.—I. D., one year old; oblique fracture of middle third, plaster case. At end of three months no disability or shortening.

End results of the three cases in which no disability was recorded at the time of discharge from the hospital.

### CASE REPORTS

CASE I.—E. G., five years old; admitted with compound fracture of the skull, fracture of right humerus, lacerations about right knee, and a supracondylar fracture with no displacement of fragments, treated in Thomas splint. Lacerated wound became infected and was Dakinized. Developed measles and transferred to isolation ward. Five months later returned to hospital with contracture of knee in position of 140 degrees extension. There was forty degrees flexion.

CASE II.—J. S., six years old; multiple contusions and transverse fracture of middle of shaft, no shortening. Plaster case. No shortening or disability at the end of five months.

CASE III.—J. Y., two years old; transverse fracture of middle of shaft, Bryant frame, home on the third day and treated there in Bryant frame. Returned in three months with no disability or shortening.

*Summary.*—At the end of one year the ninety-eight cases presenting limitation of flexion had a full range of motion.

Of the three cases of outward rotation two were apparently normal at the end of this period.

Only one of the five cases of angulation persisted at the end of one year, and the two cases with talipes equinus deformity on discharge were corrected at the end of one year.

### CONCLUSIONS

Fractures of the femur in children are almost invariably followed by a good functional result. A satisfactory anatomical reduction is not essential for perfect function.

In our experience children up to the age of six are best treated in a Bryant frame. Over six, plaster spica with traction.

## FRACTURES OF THE FEMUR IN CHILDREN

Suspension treatment in a Hodgen or Thomas splint is not practicable except in compound fractures, simple fractures with laceration, or severe trauma to adjacent tissues, where the administration of an anæsthetic is contraindicated and when skeletal traction is to be employed.

The majority of cases which are discharged with shortening will be spontaneously corrected within one to two years.

A certain number of cases irrespective of the form of treatment will be followed by a lengthening of the fractured side.

An open reduction is rarely indicated, as skeletal traction will almost invariably correct any marked deformity.



TRANSACTIONS  
OF THE  
NEW YORK SURGICAL SOCIETY  
AND OF THE  
PHILADELPHIA ACADEMY OF SURGERY

*Joint Meeting Held January 24, 1923*

DR. JOHN A. HARTWELL, in the Chair

PERFORATED DUODENAL ULCER AND BLEEDING JEJUNAL ULCER

DR. JOHN DOUGLAS presented a young man, twenty-three years old, who had had an acute perforation of a duodenal ulcer, July 19, 1921. He was operated on eight hours after perforation. A large indurated ulcer, situated just distal to the pylorus, had perforated. Because of the extensive induration and oedema, excision of the ulcer could not be done and closure of the perforation seemed to obstruct the pylorus to such a degree that a gastrojejunostomy was performed, a procedure which he usually does not follow in the presence of acute perforation. His convalescence was interrupted by the development of a large subdiaphragmatic abscess in the right side which was drained by resection of the tenth rib under local anaesthesia.

On February 10, 1922, seven months after operation, he had a large hemorrhage from the bowel, and again on September 10, 1922, a large hæmatemesis, followed by several tarry stools, causing marked anæmia. Radiographic examination at this time showed nothing diagnostic. October 31, seven weeks later, he had another large hemorrhage from the stomach which was repeated the same evening, reducing his red blood cells to 1,900,000 and his hæmoglobin to 30 per cent. After three direct blood transfusions during the next two weeks, it was decided to again operate on him as his stools continued to show the presence of blood. It could not be decided at this time whether the blood was coming from his old unhealed ulcer, a new ulcer or a jejunal or gastro-jejunal ulcer, although he at no time had complained of the severe pain which is usually associated with the latter lesions. His only subjective symptoms other than the hemorrhages were occasional gastric discomfort and gas pains in the left side of the abdomen and a severe attack of diarrhoea a week before his last hemorrhage.

At operation on November 18, 1922, it was rather surprising to find very few adhesions about the pyloric region, notwithstanding the local peritonitis, following the perforation, and the subdiaphragmatic abscess. The old ulcer showed a very small smooth scar, with no thickening about it or the pylorus. Just distal to the site of the gastrojejunostomy was an indurated area in the jejunum. While holding up the jejunum in order to separate the intestine and stomach at the point of anastomosis



FIG. 1.—Section from nodule on serosa of stomach showing "stone cells."<sup>29</sup>



## PERFORATED DUODENAL ULCER

this area tore through, revealing an ulcer, evidently at the point of perforation. This ulcer was not marginal, as the continuity of the gastric and intestinal mucosa was flawless at all points along the edge of the stoma. No non-absorbable suture material had been used in the anastomosis. The stomach and jejunum were separated and the wounds in each closed with chromic catgut and the abdominal wound closed without drainage. Recovery was uneventful and the patient has been free of symptoms and has gained twenty pounds since his operation. Radiographic examinations, however, during the past few days, show that he has a considerable degree of six-hour retention. The patient is presented because of the early development of the jejunal ulcer, and the severe massive hemorrhages occurring therefrom, although he suffered from very little of the pain which is usually a prominent symptom in the presence of this lesion.

## PERFORATED DUODENAL ULCER

DR. JOHN DOUGLAS also recited the history of a patient eighty-one years old, first seen on October 24, 1922. His gastric symptoms dated back only three or four months, during which time he had suffered from pain and discomfort after eating, loss of flesh and strength and increasingly frequent vomiting. Careful questioning elicited no previous history of stomach symptoms. Radiographic examination demonstrated an advanced degree of pyloric stenosis with a large twenty-four-hour retention. There was no defect in the stomach outline indicating carcinoma and examination of the gastric contents showed normal total acidity and free HCl. It was therefore believed, notwithstanding his age, that he had a benign stenosis, and as his blood-pressure, blood sugar and blood urea and kidney function tests were all remarkably good for a man of his age, operation was advised. He was operated on under local novocaine anaesthesia on November 15, 1922.

At operation the pylorus and first portion of the duodenum were found buried in dense adhesions which could not be separated or satisfactorily explored under the local anaesthesia, but no mass could be felt anywhere in the stomach, nor were the regional glands enlarged. On the anterior wall of the pyloric end of the stomach were two small white nodules about the size of the head of a pin, attached to the serous layer of the stomach wall. These had the appearance of and were believed to be carcinomatous implants, secondary to some primary growth, and were removed for diagnosis. A gastrojejunostomy was then done.

The pathological report from these specimens received was "vegetable cells in the serosa of the stomach," and Dr. F. C. Wood, the pathologist, informed me that these cells were the so-called "stone cells" (Fig. 1.) which occur in the pulp of pears and some other fruits and could only have reached their present location as a result of a perforation of the stomach or duodenum. The following day it was learned from the patient that two years previously during the summer, he had suffered from a severe attack of abdominal pain most marked in the right hypochondrium. This pain was so severe that he had fallen

## NEW YORK SURGICAL SOCIETY

to the ground and been unable to get up. He received morphine, was kept in bed for about two weeks, and then entirely recovered, having no stomach symptoms until two years later when his pyloric stenosis developed. It is therefore quite evident that he had an acute perforation from which he recovered without operation at the age of seventy-nine years. The patient is shown because of his recovery from an acute perforation without operation at the age of seventy-nine, the occurrence of a benign stenosis of the pylorus at the age of eighty-one and the curious manner in which the diagnosis of perforation was made.

### PERFORATED DUODENAL ULCER IN A CHILD

DR. WILLIAM A. DOWNES presented G. J., aged three. Admitted to St. Luke's Hospital on December 28, 1922. Discharged January 19, 1923. Diagnosis: Acute perforated duodenal ulcer. Chief complaint: Vomiting and pain in abdomen. Present illness: Began six days ago with vomiting. Vomitus at first contained food, and later became bile-stained. There was no temperature or pain. All food by mouth was stopped and was given nothing but water. On the fourth day was put on small quantities of barley water. Vomiting ceased and child seemed to be better. About ten o'clock on the morning of the sixth day complained of a sudden severe pain in the upper abdomen and immediately vomited a large quantity of brownish material. Vomiting and pain continued during the day, and there was a gradual rise in temperature. A blood count showed 12,000 leucocytes, and a polymorphonuclear count of 82 per cent. The case was considered a surgical one with a probable diagnosis of acute appendicitis.

Upon admission to the hospital at eight P.M., December 28, temperature had risen to 102. There was slight rigidity over the entire abdomen with moderate distention in the epigastric region. An indefinite resistance could be felt to the right and above the umbilicus, giving the impression of an enlarged liver. A blood count showed leucocytes 20,000, polymorphonuclears 92 per cent. In view of the rapid change in the blood count, increasing temperature and the indefinite mass in the upper right quadrant, an exploratory operation was decided upon. Provisional diagnosis: Acute appendicitis with the appendix situated high up under the liver. Mid-rectus incision: Immediately upon opening the abdomen a large quantity of bile-stained fluid escaped. The gall-bladder was found distended and upon exposing the duodenum a perforation about one-eighth of an inch in diameter was found on the anterior surface just distal to the pylorus. There were no adhesions about the perforation and a bloody fluid could be seen escaping from the opening. Perforation was closed by purse-string suture of fine chromic catgut reinforced by several interrupted sutures. All fluid aspirated from the abdominal cavity and wound closed without drainage. Convalescence uninterrupted. Child was discharged from the hospital on the twenty-first day post-operative. X-ray examination made on the seventeenth day after operation showed the stomach to be functioning normally.



## PERFORATED DUODENAL ULCER IN A CHILD

DR. JOHN GIBBON remarked that in a large perforation closed with difficulty and where an omental graft is unsatisfactory, or where infolding of the ulcer results in obstruction, the artificial stoma is indicated. However, if one has observed many perforations from typhoid, one realizes that the obstruction from infolding is more apparent than real as shown at autopsy or at operation for a second perforation. In the case operated upon within a few hours after perforation, it is a question whether gastro-enterostomy should be done. There is a type in which it should not be done and that is where the patient is very ill and where prolongation of the operation adds greatly to the risk. One of the interesting features of this question is what happens to the ulcer after simple closure without gastro-enterostomy. He had had occasion to operate upon three patients in whom a simple closure at the first operation was done. The interval between operations in these cases, sixteen months, nine years, and fifteen years. Each was apparently well after the second operation. Without a gastrojejunostomy, nearly all of these cases will get well and have no further trouble. Fourteen years ago the speaker, in conjunction with Doctor Stewart, reported (*J. A. M. A.*, March 6, 1909) twenty-two cases of perforation on which they had operated, and every case operated on within eighteen hours got well, and every case operated on after eighteen hours, with one exception, died. In late cases it would seem more advisable not to do a gastrojejunostomy.

DR. GEORGE P. MULLER thought that the tendency at the present time in the non-perforative cases was to excise the ulcer with or without gastro-enterostomy; if one was able to operate early in a simple perforation then one could practice such excision and not do a gastrojejunostomy. All writers agree that those cases seen after thirty-six hours will die and yet we teach that they are the ones in which we simply should open the abdomen and establish drainage; the stomach has no chance to empty against the advanced infiltration and œdema, so we ought to be more radical in these cases and by doing gastrojejunostomy perhaps reduce the one hundred per cent. mortality. The speaker recalled a case which resembled the first case of Doctor Douglas. A physician who was operated on in 1914 for perforated ulcer and on August 22, 1922, had a severe hemorrhage. He was given rest and cold treatment, but had another hemorrhage, and after transfusion the stomach and jejunum were opened, but no ulcer could be found. The gastrotomy was closed and the patient entirely recovered.

DR. EUGENE H. POOL said that it seemed to be in the minds of some surgeons that if gastrojejunostomy could be done in conjunction with closure of the perforation, it would insure a permanent cure and prevent future symptoms. It is true that a gastro-enterostomy will prevent symptoms from subsequent pyloric obstruction; but, on the other hand, it will add an appreciable risk, first, of marginal ulcer (2 per cent.), second, a real risk of discomfort and functional distress (about 25 per cent.), which attends all gastro-enterostomies. Therefore, the policy at the initial operation should be

to avoid a gastro-enterostomy, if possible, rather than to do a gastro-enterostomy, if possible. Gastro-enterostomy should be reserved for those conditions mentioned by Doctor Gibbon. When no gastro-enterostomy is done the patient should be carefully watched and a gastro-enterostomy made when and if indicated. Deferred gastro-enterostomy is apparently necessary in about 33 per cent. of the cases.

DOCTOR DOUGLAS, in closing the discussion, explained that the reason he had done a gastro-enterostomy in this patient was because he was certain that he had closed the pylorus to such an extent that pyloric obstruction would result. He thought that in most of these perforated ulcer cases the patients were better off without gastro-enterostomy and agreed with Doctor Gibbon that this procedure was rarely necessary.

#### HYPERNEPHROMA OF OVARY IN CHILD

DR. WILLIAM A. DOWNES presented a second case. T. B., aged three and a half years. Admitted to St. Luke's Hospital on May 4, 1922. Discharged May 20, 1922. Diagnosis: Hypernephroma of the right ovary. Chief complaint: Pain and abdominal distention. Present illness: Began about ten days ago, at which time child complained of sudden severe pain in the lower abdomen. This pain lasted about one-half hour. A few days later complained of a similar attack of pain, lasting about same time. Mother then noticed rapid increase in the size of the abdomen, although she thinks there had been some distention for the past year. On the day of admission to the hospital, child had a temperature for the first time which was later explained by the fact that measles developed two days after the operation. Mother states that the patient has always been considered precocious, acting and talking like a much older child. An unusual development of the external genitals with the appearance of pubic hair was noted some months before the onset of the present symptoms. General health always good. Physical examination showed a well-developed and well-nourished child. Head, neck, thorax and extremities normal. Abdomen much distended, apparently containing a large amount of free fluid. A freely movable mass about the size of a baseball can be felt to the right and below the umbilicus. No tenderness, no rigidity. Provisional diagnosis: Tubercular peritonitis.

Operation, May 5, 1922.—Lower right rectus incision. Immediate escape of a large quantity of straw-colored fluid. The tumor which had been palpated was found to arise from the right ovary and measured about 14 x 12 x 12 cm. The peritoneal covering was congested and the pedicle gave the appearance of having been recently twisted. Left tube and ovary normal. There was no evidence of metastasis in the parietal or visceral peritoneum. The pedicle which was about 3 cm. in width ligated with No. 1 gut. Wound closed in usual way. Convalescence complicated by measles. Discharged from hospital on the sixteenth day. Condition of child at the present time excellent.

Pathological Report.—Diagnosis, hypernephroma of ovary. Tube

## HYPERNEPHROMA OF OVARY IN CHILD

normal. Macroscopical examination: Specimen consists of a tumor of the right ovary with tube attached. The surface of the ovary is smooth and shining and shows minute cysts as well as diffuse congestion of the underlying mass. It measures 14 x 12 x 12 cm., is semi-fluctuating, at one end soft, but at the other cellular. On section there are several broken-down areas at the cystic end, the cavities being filled with bloody serous fluid. About half the mass is yellow, opaque, and consists of rounded tumor masses and a slight amount of hemorrhagic stroma. The growth has no capsule aside from the ovarian wall. The tube is normal. Microscopical examination: Section of the tumor shows a very cellular growth in which there are numerous areas of necrosis. No ovarian tissue appears in the sections, but a very delicate stroma supports the diffuse growth of large cells which are arranged in the form of small alveoli without lumen. For the most part, in the better preserved portions of the tissue, the cytoplasm is either clear or granular, but the cell walls are uniformly well defined and the nuclei small, comparatively regular and stain deeply. Occasionally multinucleated cells are found, but these are usually in the more degenerated portions and suggest involution structures. The growth is extremely vascular and contains large numbers of sinuses with only a single endothelial support. The growth as a whole strikingly resembles tumors of the adrenal cortex, and it is probable that the chromaffin cell furnished an origin for it. Carmine stains show scattered but fairly numerous granules of collagen within the cells.

DR. JOHN SPEESE alluded to a case which came under his observation a few weeks ago. The child, an hermaphrodite, nine days old, was admitted to the Children's Hospital with symptoms of congenital pyloric obstruction, for which an exploration was done. The operation revealed a pylorus somewhat thickened and spastic, the characteristic tumor of congenital hypertrophy was not present. Having in mind the possibility of an early stage of such an hypertrophy, the serosa was divided over the thickened area. The vomiting which had persisted from birth was relieved for several days and there was a slight gain in weight. A recurrence of vomiting occurred, however, which was uncontrollable, and death resulted one week after operation. The autopsy revealed a patulous pylorus; bilateral hyperplasia of the adrenals, the right one, adherent to the surrounding tissues, was the size of the kidney, and was the tumor felt before operation and erroneously diagnosed as pyloric hypertrophy.

From the clinical point of view the case was regarded as spasm of the pylorus and in view of the autopsy findings the condition seems of some importance. The connection of adrenal hyperplasia and hermaphroditism has been established. The relationship between adrenal disease and such a gastric neurosis is of interest, particularly in respect to the experimental work of Friedman, who some years ago endeavored to show a relationship between the development of gastric ulcer and disturbances in the ductless glands. He found that spastic conditions of the stomach musculature were caused by

deficiency in parathyroid or epinephrin secretions, or by excesses of one or more of the thyroid products. If a true diminution in secretion of the adrenals followed disease of the gland in the case mentioned, it is interesting to speculate as to the possible value of the administration of adrenal gland extract in cases of this type.

DR. WALTON MARTIN said that in regard to the explanation of the increase in pubic hair growth, the stimulation of the ovary, due to the presence of the growth, would cause this, and referred to the case of a child of five with tumor of the ovary, and of a boy of seven with tumor of the testicle, in both of whom this phenomenon had occurred, to disappear on removal of the growth.

DR. HOWARD LILIENTHAL did not believe the hair-growing symptom to be entirely a sex matter, but that it was connected with some disturbance of the adrenal secretion. It is on record that hypernephroma has stimulated the unusual growth of hair and this coming on suddenly is one of the diagnostic points of the presence of hypernephroma.

#### SEPSIS FOLLOWING TONSILLECTOMY

DR. EDWARD W. PETERSON showed a child, Martin G., four years of age, who had had his adenoids and tonsils removed by another operator previous to being seen by the speaker. The patient was allowed to go home on the day following the operation and that night was found to have a temperature of  $104^{\circ}$ . There was swelling at the angle of the jaw on both sides of the neck. When examined he had a temperature of  $105^{\circ}$ , was apathetic, somnolent, and decidedly septic looking. The general examination was negative except for a dirty looking membrane in the tonsillar spaces and a suppurative cervical adenitis, just below the angle of the jaw on the right side. Incision and drainage of this abscess made no impression on the general condition. For the first ten days his temperature was constantly high, ranging from  $102^{\circ}$  to  $106^{\circ}$  F., then it became intermittent and ranged from  $97^{\circ}$  to almost  $107^{\circ}$ . For forty-seven days he had more or less fever.

While in the beginning the patient was apathetic, somnolent, and wished to be left undisturbed, later he was extremely hyperæsthetic, wakeful, fretful, and cried a great deal. Several times he had severe chills. He lost weight and strength gradually and showed a moderate, secondary anæmia. Blood cultures were negative. When the sepsis reached a subacute stage a transfusion of 320 c.c. of unmodified blood was given into the left external jugular vein by puncture, by the syringe cannula method. There was a decided fall in temperature, gain in appetite and in strength and improvement in the boy's general condition. This lasted for several days, when the temperature began to rise again. There developed at this time a hard swelling in the left parotid region which gradually increased, until the left eye was closed. Later fluctuation could be detected just above and in front of the left external auditory meatus. Incision into this mass revealed a periostitis of the mandible on the left side just below the articulation. Another



## SEPSIS FOLLOWING TONSILLECTOMY

transfusion was given at this time. Following the drainage of this focus of infection and the blood transfusion the temperature dropped to normal and convalescence was rapid and complete.

DR. W. E. LEE said he had recently had a patient who, after very careful matching with a number of donors, was transfused by the citrate method with 500 c.c. of blood without any immediate reaction. One-half hour afterward, however, he developed a typical anaphylactic protein reaction with high fever, spasm of the unstriated muscles, asthmatic symptoms in the lungs with involuntary voiding of urine and several bowel movements. This subsided after one hour, but the man developed acute oedema of the lungs and died eight hours after the transfusion. During the reaction the urine was examined and no hæmoglobin found. The blood showed no hæmolysis or agglutination.

DR. GEORGE P. MULLER referred to a case he had under his care on whom a tonsillectomy had been done under local anæsthesia. One week later a swelling appeared on the left side of the neck, which subsided, followed by swelling on the right side of the neck, for which he was admitted to the hospital. He was very ill with a temperature  $103^{\circ}$ . An incision was made in the neck and an abscess found beneath the jaw and extending under the sterno-cleidomastoid muscle towards the posterior triangle. A counter-incision was made and Carrel-Dakin irrigation used. The colon bacillus and staphylococcus aureus were cultured from the pus. Four days later a second collection made its appearance at the lower end of the scapula, and three days after this a third collection appeared over the crest of the ilium. Both were drained. He was discharged, but two weeks later the left side of the neck became swollen and he was readmitted apparently very ill. While walking to the ward the man dropped dead. No autopsy was obtained. Regarding the use of blood transfusion in chronic septic cases, he has had remarkable results in many.

DOCTOR PETERSON, in closing, said that he had had one transfusion experience similar to that of Doctor Lee. A woman with an extreme degree of anæmia, having only 740,000 red cells, a leucopenia and a hæmoglobin of only 10 per cent. Preliminary blood compatibility tests were made and found satisfactory. The transfusion was started by the syringe-cannula method. With the injection of the first syringe of blood the patient stated that she was dying, became restless and hysterical. The lips and eyelids became rapidly swollen and a giant urticaria came out all over the body. The transfusion was stopped at once and for the next twelve hours the patient was critically ill with temperature, delirium, and showed every evidence of a severe anaphylactic shock. She recovered and later several transfusions were given without any anaphylactic reaction, and with great improvement in the anæmia.

With regard to transfusion, Doctor Peterson believed that the procedure did no good during the acute stage of a sepsis, but that in the subacute or



chronic stage, blood transfusions did good through their strengthening and stimulating influence, rather than through any special bactericidal or anti-toxic properties.

#### BILATERAL, MULTIPLE KIDNEY ABSCESESSES

DR. EDWIN BEER presented the following case: J. L., male, twenty-two years old. Admitted Mt. Sinai Hospital, May 16, 1922. Discharged June 23, 1922. The patient was well until ten weeks before admission, when he had a mild infection of the toe. Two weeks later he developed an infection of the right index finger, and two weeks later he developed a cold in the head, and while in bed an abscess of the scalp. At this time he had a temperature for two to three days. Seventeen days prior to admission, he developed some pain in the left lumbar region with fever of irregular character, and was confined to bed. Since then he has had pain in the left lumbar region and tenderness, irregular temperature, no chills, and no urinary symptoms.

His physical examination showed a very pale, septic looking patient. His general physical condition was negative, but in the left lumbar region there was a marked tenderness but no mass to be felt. His blood count showed 29,600 white cells with 86 per cent. polymorphonuclears. His urinalysis showed a trace of albumen, some casts, and a few white blood-cells. Pre-operative X-ray of the genito-urinary tract was not satisfactory, but showed no stone. Pre-operative diagnosis was cortical abscess of the left kidney with possibly perinephric abscess.

On May 16, 1922, under gas, a left lumbar kidney incision was made and a perinephric abscess encountered. The thickened capsule of the kidney was turned back and multiple cortical abscesses were incised without delivering the kidney. The capsule was much thickened and cedematous. In one place the cortical abscesses were so grouped as to suggest a suppurating infarct or carbuncle. Rubber dam was placed in front and another behind the kidney and a tube between the two sheets of rubber. The wound was left wide open. The culture of the abscesses showed staphylococcus aureus. From May 17 to May 23 the wound was irrigated daily and the kidney regularly palpated in the wound and several soft suppurating areas in the cortex were broken up with the finger. During this period the temperature gradually diminished and the patient seemed to be convalescing, when suddenly on the 23rd his temperature rose to  $105^{\circ}$ . The wound was then explored with the finger and considerable pus evacuated, the kidney being easily palpated in the bottom of the wound. There was some urinary leakage from the kidney into the dressing. May 24, the next day, the temperature dropped to normal and it seemed as if the previous day's digital exploration had controlled the situation. Throughout this period the urine was clear, showing a trace of albumen, a few casts, and occasionally a few pus cells.

May 25 to 26 the temperature again arose. Blood culture was negative and tenderness was recognized in the right lumbar region. May 27 the temperature rose to  $103.8^{\circ}$  and in the right lumbar region on

## BILATERAL, MULTIPLE KIDNEY ABSCESES

deep pressure tenderness somewhat more marked. Exploration with the finger of the left lumbar wound gave no explanation for the rise in temperature, and on May 29 it was decided that the patient, whose right kidney area was tender, probably had cortical abscesses in the right kidney with some perinephritis. On that day, a right lumbar incision was made and the lower pole of the right kidney was found necrotic and surrounded with thick green pus; perinephric tissues were thickened and oedematous. The right kidney was decapsulated *in situ* just as the left kidney had been, and multiple abscesses, some as large as cherries, were opened bluntly. Drainage with two sheets of rubber dam on either side of the kidney and tube between. Wound left open without any sutures. After this operation, the wounds on both sides being dressed and irrigated daily and rubber dam being withdrawn gradually; the patient's temperature became normal within two weeks. During this period several small areas in the right kidney were bluntly opened at dressings with palpating finger. From the right wound there was also moderate urinary leakage. Beginning the third week the patient had sufficiently recovered strength to be out of bed, and on June 22—about five weeks after his first kidney operation, he was discharged from the hospital.

In addition to the rapid recovery and the open method of treatment after decapsulation the most interesting features in this case are the apparently metastatic character of bilateral kidney abscesses; the absence of frank pus in the urine in some twenty-three examinations; and the remarkably firm union of both large lumbar wounds which had been left wide open without any sutures. Since the operation the patient has gained about forty pounds.

DR. CHARLES H. PECK said that although he had seen no case of bilateral multiple kidney abscesses, he had seen many cases of unilateral infection of the kidney. He considered that Doctor Beer's case emphasized one point and that was that these cases should be treated conservatively. In many of them the clinical symptoms will subside without operation. In another form abscess of the cortex will form without involving the pelvis or the urinary tract, and the urine remains free from pus. These can often be treated by local drainage without sacrificing the kidney. Only a small percentage go on to demand nephrectomy, even bearing in mind that the onset may be very sharp. With a little patience this violent initial stage will pass off and the patient recover.

DR. HOWARD LILIENTHAL referred to two cases he had had of bilateral multiple kidney abscesses which he treated the same as had Doctor Beer. The first was the result of a streptococcus infection of the face and the patient was in the hospital nine months. His second bilateral case was four years ago, a soldier in the American Army, who developed a phlegmon of the left arm and from that had lung abscesses and bilateral kidney abscesses. He was treated similarly to the first case and got well.

DOCTOR BEER believed that it is necessary to distinguish carefully between those cases with pyuria and colon infection and those cases without pyuria where the infection is probably due to coccic group of bacteria. In the latter, incision of the abscesses with decapsulation, at times resection of the infarcted area, and rarely nephrectomy seem indicated; whereas in the colon group nephrectomy, except in diabetics whose kidneys apparently are not able to take care of the multiple abscesses, is usually contra-indicated. If there is no obstruction to the outflow of urine, those cases usually take care of themselves, though some require decapsulation and, if stone is present in the ureter or pelvis, the removal of the stone may be necessary. The case that Doctor Lilienthal referred to, following erysipelas of the face, is a classic example of conservative treatment and has been quoted for years in literature. These cases of bilateral coccic infections of the kidney are very uncommon. He had seen only three similar cases and they were all treated as in the case presented with satisfactory end results.

#### SPLENECTOMY FOR HÆMOLYTIC JAUNDICE

DR. EDWIN BEER also presented a child, six years of age; admitted September 22, 1922. Present trouble began one week before admission with temperature and vomiting and progressive pallor. On admission, spleen five fingers below costal border. The liver was just palpable and there was a slight enlargement of the heart to the left, and a general adenopathy. Hæmoglobin, 43 per cent.; red blood cells, 2,000,000; white blood cells, 34,000; increased fragility of red blood cells; blood Wassermann negative; urine negative. While in the hospital on October 24, the patient developed some abdominal pain and icterus. On October 31 the temperature went up to 102, and icterus again became apparent. On December 12 the patient again had an attack of pain in the abdomen with tenderness and again became icteric. On December 13 the hæmoglobin had dropped to 32 per cent., and on December 17 there was again some icterus. The examination of the blood serum for bile showed a positive indirect VandenBergh, which, together with the increased fragility of red blood cells plus the enlarged spleen, made the diagnosis of hæmolytic jaundice. In the stools and urine there was an increase of urobilin. As the rest of the family showed no similar disturbance, this was apparently a case of acquired hæmolytic icterus in which there were icteric periods alternating with non-icteric periods.

Doctor Schwarz, on whose service the patient had been carefully studied, transferred the patient to the surgical service, where, on January 10, 1923, a splenectomy was done under gas-ether through a sub-costal incision. The spleen was found to be enlarged and was removed after ligation of the pedicle, abdominal wound being closed in layers without drainage. The pathological report from Dr. F. S. Mandlebaum is as follows: "The spleen removed from E. S. measures 11 x 8 x 4 cm. and weighs 225 gms. The surface is smooth and the vessels at the hilus are patent. The cut surface of the spleen is quite succulent and dark red in appearance with no visible evidence of fibrosis. The Malpighian

## CHRONIC BILIARY FISTULA

bodies appear numerous and considerably enlarged. Smears made from the fresh surface show a large number of red blood cells, the usual forms of white blood cells and a marked preponderance of lymphoid elements. Large numbers of agglutinated blood platelets are also present. Microscopic examination shows hypertrophy of the Malpighian bodies, marked congestion of the pulp, moderate phagocytosis, and the presence of iron pigment in the cells lining the sinuses."

The patient has made an uneventful recovery, two weeks having elapsed since the operation, and has had an absolutely afebrile course since the operation without any return of icterus. Five days after the operation, blood examination showed 80 per cent. hæmoglobin and 4,650,000 red blood cells.

DR. CHARLES H. PECK spoke of the satisfactory results from splenectomy in hæmolytic jaundice. He had operated on three cases in the past few years, one a boy of fourteen of the familial type; all have remained quite well. A fourth case, of the hereditary type, had cholecystectomy performed for gall-stones six years ago without splenectomy and had remained comparatively well without increase of symptoms, but the jaundice persists.

## CHRONIC BILIARY FISTULA IMPLANTATION OF SINUS INTO THE STOMACH

DR. HOWARD LILIENTHAL presented a woman, thirty-one years old, operated upon for cholecystitis with gall-stones in 1917, cholecystostomy and drainage having been performed. After two years of relief she began to have deep epigastric pain running to the back. She also had a gynecological trouble, for which she entered Mt. Sinai Hospital on September 20, 1921, where an amputation of the cervix for a non-malignant condition was done. It was intended to remove her gall-bladder when she should have recovered from the gynecological operation, but an acute suppurative cholecystitis came on two days afterward and necessitated a reopening of the gall-bladder without delay. This was done by Dr. Harold Neuhof, and by October 27 things had quieted down and she was ready for her radical operation. The external gall-bladder wound was still patent and discharging bile. The operation proved difficult, but was finally successfully performed, the common duct being incised and a number of stones milked out. The choledochotomy was a long one made in the direction of the duct, so that the great mass of calculous material and detritus could be expressed. Probing of the hepatic duct disclosed more stones which were removed as well as possible with the blunt curette. Probing into the duodenum was not entirely satisfactory, and, since the operation had lasted about an hour, and the patient was not in the best of condition, it was decided to terminate the procedure. A closely fitting rubber drainage tube was passed into the hepatic duct and held there by a single fine chromic catgut stitch. The stools of this patient had never been acholic, so it was hoped that when the hepatic tube would be removed the bile would again find its way out through the natural channels. This was not



the case, however, all the bile escaping at the wound even when the tube had been removed. About two months after the operation it did not look as if the bile would again find its way through the natural channels and it was decided to again operate to close the fistula, a formidable procedure in the presence of the mass of tough and extensive adhesions at the former operative field. On December 18, 1921, an incision was made transversely just above the old scar and continued upward in the median line for about three inches. The fistulous opening was circumcised, leaving a thin collar of skin and the sinus freed from its adhesions. When the stomach was reached the implantation of the sinus looked so feasible and tempting that it was decided to make the experiment. Accordingly a gastrotomy was performed about  $2\frac{1}{2}$  inches from the pylorus anteriorly and about one-third of the way from the lesser to the greater curvature. A straight needle was then plunged into the stomach through the greater curvature, carrying a piece of thick silk, and this, after traversing the interior of the stomach, was led out at the gastrotomy wound which had been made. The silk was fastened with a suture tied in a bow-knot to the tough structure of the fistulous tract near the skin. Traction upon the silk was made outside the puncture where it had entered the stomach. The fistula with sinus was drawn into that organ, where it was held by four or five chromicized catgut sutures passed through the outer coats of the stomach. Further inversion of the anastomosis was then made and maintained by suture. Before the last row of sutures was put in the end of the bow-knot which had been left outside was drawn upon, untying the knot so that the silk could be extracted through its place of entrance. To test the imperviousness of the suture line, a stomach tube was inserted through the œsophagus and the stomach filled with air, while water was dripped over the line of suture. No bubbles escaped. The wound was then closed in two layers with drainage by rubber dam. Three days later the patient stated that she occasionally brought up faintly bile-tinged mucus. A week after the operation, although there was no gastric leak, bile appeared for a time at the wound. This leak, however, was of short duration, and the wound then healed promptly. There was never a trace of icterus, the patient was greatly relieved, and she was discharged from the hospital apparently well about two months after the plastic operation.

DR. JOHN H. JOPSON said that a year ago he had presented a case operated on for biliary fistula in which he established an anastomosis between the first portion of the common duct and the stomach, that had remained in perfect health one and one-half years after the operation. Dr. Ellsworth Eliot, in 1917, read a paper on "Repair and Reconstruction of the Bile Ducts," collecting and analyzing all of the cases on record. Many methods were described by different operators in different series. He included at that time eight cases in which the hepatic or the common duct had been anastomosed with the stomach. A study of Eliot's paper makes one realize that there is a great deal to be desired in the end-results of many of these cases; attacks of pain and



## CHRONIC BILIARY FISTULA

jaundice are frequent in the post-operative histories. The chances of an ascending infection of the duct after operation probably increase as one goes down the bowel. The anastomosis can be made to the stomach with comparative ease, and there seems to be less chance of ascending infection than when the anastomosis is made into the duodenum or lower down in the intestine. The speaker had once completely divided the duct during an operation for cancer of the stomach, and performed immediate end-to-end suture with excellent result. The patient remained well after several years.

DR. FRANK H. LAHEY (by invitation) referred to two successful cases of transplantation of a common duct fistula into the duodenum. His own case was done on October 19, 1922, for a common duct fistula following operation for pancreatitis. The fistulous tract was coned out, care being taken to leave a thick wall about it to diminish the possibility of slough. This was transplanted into the duodenum, sewing a small No. 16 rubber catheter inside the fistula to maintain its patency during the healing. The abdominal wall was closed without drainage. The stools immediately became bile-colored and have remained so up to the present time. There has been no return of the fistula. This case was done without knowledge of a similar case done nine years ago by Dr. Hugh Williams at the Massachusetts General Hospital, who transplanted a common duct fistula into the duodenum and the patient, who has recently been seen by Doctor Williams, has remained entirely well with bile-colored stools and no return of the fistula up to the present time.

DR. JOHN GIBBON brought up the question whether so many persistent common duct fistulae would occur if one did not remove the gall-bladder in the presence of stone, sand or mud in the common duct. He was convinced that it is a mistake to take the gall-bladder out when there is cholangitis. If the gall-bladder is left, the common duct can be drained and no fistula will follow. The common duct, if drained in the absence of the gall-bladder, remains open much longer than when the gall-bladder is present. If the gall-bladder is left in the above conditions these persistent fistulae will not occur.

DR. WILLIAM A. DOWNES wished to know the experience of the members with reference to the permanency of a cure in operations for injury to the common duct. Six years ago in operating for gall-stones, he accidentally removed about one inch of the common duct and an end-to-end suture was done, which seemed to be very satisfactory. The patient was lost sight of, but a few days ago he turned up in the hospital intensely jaundiced. He was operated upon, and after freeing the duodenum, which was found adherent to the under surface of the liver, a half inch of dense cicatricial tissue was found at the site of the injury in the common duct. The cicatricial material was excised and a T tube inserted. He is convinced that these cases of injury to the duct, no matter how satisfactorily repaired, contract, and that this is the usual result. If the duct is injured, he wondered if it would not be wise to immediately anastomose the duct to the stomach or duodenum. The above case is the only one of injury to the common duct in his own hands,

but he had operated upon four other cases in which the duct had been injured and the late results have been satisfactory in only one case.

DR. JOHN DOUGLAS answered Doctor Downes' question to a certain extent. About one year ago he showed a patient who had destruction with separation of about 1 cm. of the common duct due to a bad sloughing and infection following cholecystectomy for a gangrenous gall-bladder. Three months before showing her, he had operated for the repair of the duct. He dissected the duct, sutured it together end-to-end and put in a T tube. The patient accidentally pulled out the tube within two weeks, but went out of the hospital apparently cured. She had remained well up to the time of showing her before the society three months later. About two months later she became jaundiced and had marked itching of the skin and clay-colored stools. She was given medicine to increase the flow of bile and finally the jaundice cleared up. That has happened to her three or four times in the past year. After acute attacks of pain her symptoms of biliary obstruction disappeared, probably due to pressure dilating again the stricture in the common duct, which has too small an amount of epithelial tissue lining the point of repair not to contract down.

DR. ALEXIS V. MOSCHCOWITZ said that he had a very peculiar experience within the past two years in connection with biliary fistula which he would like to place on record. About two and one-half years ago, he had occasion to do a simple cholecystectomy for cholelithiasis. The operation was exceedingly simple and easy; in fact, the entire operation did not last half an hour. The specimen removed was the gall-bladder filled with calculi and a short stump of the cystic duct. The patient did well for three or four days, then suddenly jaundice developed which persisted for about one week and ceased only after the discharge of a slough from the depth of the wound, whereupon a biliary fistula formed. This biliary fistula remained permanent. He reoperated and found an opening on the under surface of the liver which was apparently the hepatic duct. No trace of the common duct was found after a two-hour search. He introduced a tube into the opening into the liver (hepatic duct), made an opening into the duodenum through which the hepatic tube was introduced, and sutured it into place. Again a biliary fistula formed which has remained open to date. All the bile is discharged externally, but in spite of this she has remained in perfect health and for the present does not wish any further operation. In view of the simplicity of the first operation, Doctor Moschcowitz is inclined to believe that there was some unrecognized abnormality in the blood supply to the common duct. It was this which caused the sloughing of the duct and the formation of the biliary fistula.

DR. GEORGE P. MULLER three months ago operated on a patient for stricture of the common duct. The patient had been suffering from jaundice and loss of weight, following a previous cholecystectomy. At operation when the stricture was dissected out, the stump of the common duct was found to be within one-eighth inch of the junction of the right and left hepatic ducts.

## OPERATIVE REMOVAL OF BRAIN TUMORS

A T tube was introduced, one end into the common duct and the other end split, one-half being placed in the right hepatic duct and the other in the left. The ends of the duct were partly sutured and omentum wrapped around the joint. The jaundice cleared up and the patient is now in perfect health. About four ounces of bile is discharging daily through the tube. The speaker said he is afraid to take out the tube. It has been in place three months, and sooner or later must come out, but he is fearful of recurrence of the stricture.

DOCTOR LILIENTHAL, in closing, expressed his belief that tubes in the common duct are apt to cause necrosis and consequent scarring which results in the persistent fistula. It seemed to him that these fistulae are much more rare now than they used to be when the gall-bladder was left in. With the removal of the gall-bladder the common duct is more carefully explored and all stones removed. If the gall-bladder is left in there seems to be a more persistent fistula than if it is removed. In his case, the fistula transplanted into the stomach is a safety valve. If the epithelium should reestablish itself in the common duct the bile may run through the natural passage. The operation is easy, and in suitable cases it may be well worth trying rather than to make a difficult and dangerous dissection. It does not prevent one from operating again if it should be thought best to make another attempt to reestablish the choledochus.

## OPERATIVE REMOVAL OF BRAIN TUMORS

DR. CHARLES A. ELSBERG presented a patient from whom he had removed a large endothelioma from the right parieto-frontal region, in June, 1922. The patient had suffered from severe headaches and failing vision. He recovered completely from the operation and was presented perfectly well.

A second patient from whom he had removed a large endothelioma from the anterior part of the left temporal lobe in August, 1922, was also presented. The tumor had given her mainly mental disturbances and subjective sensations of numbness in the left hand. At the operation a large endothelioma was removed from the fronto-parietal region. The patient recovered completely and was presented perfectly well.

DOCTOR ELSBERG also presented a third patient who was seen in status epilepticus, and from whom he removed a large endothelioma ten days before. Excepting for slight weakness in the right hand, the patient had recovered entirely.

In connection with these cases, all of whom were operated upon under local anæsthesia, Doctor Elsberg spoke of its advantages in many operations for brain tumor. He also spoke of the difficulties in characterizing the histological structure of these tumors which were derived from the membranes and were usually adherent to the dura. They had been called by different names; most often they have been called endothelioma, and on account of the diversity of opinion, Doctor Cushing has recently taken a backward step in a forward direction by calling them meningioma. The tumors can clinically be divided into two

## NEW YORK SURGICAL SOCIETY

groups, those that have a well-marked capsule which is often vascular, and those that have a thin or ill-defined capsule.

DR. J. S. RODMAN stated that endothelioma was the best type of tumor of the brain in which to obtain favorable results. One of the difficulties in operating for brain tumor is the matter of increased intracranial tension, and the speaker asked Doctor Elsberg how he managed cases of hypertension and what he thought of intravenous injections of hypertonic salt solution. The idea of this is, of course, to decrease brain bulk and Doctor Rodman said he had used it in a few traumatic cases, where he believed it to be of value. He also asked Doctor Elsberg what he thought of radium and X-ray treatment in inoperable tumor of the brain.

## PROLAPSE OF THE RECTUM

DR. A. V. MOSCHCOWITZ presented the history of a patient with prolapse of the rectum whom he operated upon three or four months ago. The patient had been suffering from symptoms of this prolapse for about a year. The case was one, however, of much gravity. She was practically bedridden, as only in the recumbent position did the prolapsed rectum return to its normal position. The sphincters were so stretched and atonic, that they did not give any support whatsoever to the rectum. The operation was the one done as a routine measure by Doctor Moschcowitz. The patient made an absolutely uncomplicated recovery and was discharged from the hospital three weeks after operation.

DR. GEORGE P. MULLER had done this operation five times, the first two in 1914 and the third in 1915. The others had been done more recently. As far as he knew no patient has had a recurrence, and the condition of the earlier ones is known. The only objection to Doctor Moschcowitz's operation is that it is very hard to perform; it is difficult, especially in the male subject, to keep the intestines sufficiently out of the way to place the first purse-string suture.

DR. WILLIAM JOHN RYAN said that the first case he operated on was five years ago and he saw the patient three years afterward, and there had been no recurrence. In two other cases operated on two years ago, there was no recurrence one and one-half years later. A technical difficulty mentioned by Doctor Muller can be overcome by anesthetizing the patient in the Trendelenburg position. When the abdomen is opened it will then be found that the intestines have gravitated upward and can easily be packed out of way.



TRANSACTIONS  
OF THE  
NEW YORK SURGICAL SOCIETY

*Stated Meeting Held February 14, 1923*

DR. WILLIAM A. DOWNES in the Chair

INTRAUTERINE PERIOSTEAL SARCOMA OF THE HUMERUS

DR. WALTER A. SHERWOOD presented a female child, born in May, 1920. Forceps delivery. At birth it was noticed that the left arm was swollen considerably beyond the normal contour. The physician, assuming that the arm had been broken, had an immediate X-ray made. It was reported that there was a fracture in the mid-portion of the shaft of the humerus and that a large callus formation was present; the condition was therefore interpreted as an intra-uterine fracture.

The swelling, however, steadily progressed, and so rapidly that the mother stated that she could notice a daily increase in size. There were no other symptoms or abnormalities. The child was admitted to the Brooklyn Hospital when three weeks old. Except for the local tumefaction, the infant was in good physical condition; the movements of the arm were not restricted. There was no elevation of temperature or pulse-rate and no evidence of inflammatory reaction. Over the left arm was a large, firm, fusiform swelling extending from the elbow almost to the shoulder and having a maximum diameter of about three and one-half inches. (Fig. 1.) The overlying skin was bluish in color, tense, and at its most prominent part the tumor seemed to be semi-fluctuant. An X-ray made at the time of admission showed the fracture before mentioned, together with the shadow of a tumor and considerable callus at the site of fracture. An exploratory incision was considered advisable for diagnostic purposes; this revealed friable tissue which bled so profusely that it was necessary to tampon the wound. A section of tissue removed was reported as sarcoma, the exact histological nature of which could not be determined. The character and rapidity of the growth were such that amputation seemed imperative, and three days later a disarticulation at the shoulder joint was done. Wound healing was prompt and post-operative convalescence was rapid and satisfactory.

It is now two years and seven months since the child left the hospital and during this period the patient has been carefully followed and examined at regular intervals. The growth and development of the child have been normal and at no time has there been any evidence of local recurrence or remote metastases.

The interesting features of this case are: First.—The apparent intra-uterine origin of the growth. Second.—The question of the pathology.



Any case reported as living for more than a year without recurrence or metastases following operation for periosteal sarcoma of long bones immediately casts suspicion on the accuracy of the pathological studies and reports. The gross specimen and numerous sections were carefully studied by our own staff and particularly Doctor Denton and sections and photographs were also submitted to Doctors Ewing and Bloodgood. Herewith is appended the opinion of Doctor Bloodgood, dated February 5, 1922:

"X-ray.—Shows a tumor shadow surrounding the lower two-thirds of the shaft of the humerus, extending over the elbow and upper third of radius and ulna. We can see new periosteal bone along the lower half of the shaft of humerus, extending into the tumor, and lighter shadow of the marrow suggests tumor infiltration. The photograph of the specimen (longitudinal section) shows a huge periosteal mass, with cystic areas, discolored by blood. The tumor is opaque white. (Fig. 2.)

"In the section sent me I can see tumor tissue invading fat, and separated from the epidermis by derma and fat. The tumor is somewhat circumscribed by dense fibrous tissue stroma, apparently fascia. Islands of fat are seen throughout the tumor. Also cavity formation, lined by tumor cells, containing desquamating tumor cells. The tumor is pretty homogeneous, cells larger than lymphoid cells, roundish, of different shapes, the so-called oat-cell predominating.

"Stroma.—Even in the densely cellular areas, the cells are embedded in a stroma which stains lightly with eosin. In other areas the cells are more separated by this stroma, giving it a myxomatous appearance, but no typical myxoma. There are numerous blood-vessels throughout the tumor, with thin walls, and some with thick, fibrous walls. I see no giant cells, no cartilage or cartilage cells; no bone. I do not know whether we could call this a primary osteogenetic tumor. It could easily be a primary tumor of the soft parts invading bone. For practical purposes it is to be classed with periosteal sarcoma.

"Doctor Denton's report on the gross appearance of the arm is that it presents a large globular swelling in the bicipital region, which extends on to the upper forearm. The swelling measures 7.5 cm. in the antero-posterior diameter and 5.5 cm. in the lateral. On the anterior surface there is a recent incision through the skin, 4 cm. long, opening directly into a cavity, 3.5 cm. deep. This cavity contains old blood clot mixed with disorganized tissue. The surrounding skin is purplish in color. Cross section of arm reveals a large tumor mass anterior to humerus. The outer surface has a grayish-yellow hue and shows a mottling of many large and small hemorrhagic areas, some of which are semi-cystic. The growth is attached to the periosteum around the middle third of the humerus, where there has been a fracture, now united, and presenting well-marked callus formation. It would seem that the tumor had originated about the site of fracture. The remainder of the humerus appears normal. The forearm is flexed to a right angle. The ulna is slightly bowed.

"Microscopic Examination.—Sections show the tumor to be composed of closely packed, short, fibroblastic cells with relatively little inter-



FIG. 1.—External appearance of tumor of arm.



FIG. 2.—Gross appearance of longitudinal section of specimen after removal of extremity.

2

## RESECTION OF STOMACH FOR ULCER

vening collagen. Hyperchromatic nuclei and mitotic figures are fairly numerous. No giant cells observed. The neoplastic tissue infiltrates muscle, nerves and fat. Portions of the growth in proximity to the large cavity noted in gross show extensive necrosis and leucocytic infiltration. In this vicinity and elsewhere large areas of hemorrhage are present. The tumor is probably derived from the periosteum."

This case may be classed as a true periosteal sarcoma of intra-uterine origin and is presented as such. It has been reported to the Codman Sarcoma Registry (number 68) by Dr. J. H. Long, who with the reporter has been jointly interested in the surgical care, pathological study and post-operative observation of the patient.

## RESECTION OF STOMACH FOR ULCER IMMEDIATE FEEDING WITH DUODENAL TUBE

DR. HERMANN FISCHER presented Mrs. M. M., age forty-nine years, admitted to the Lenox Hill Hospital, December 27, 1922. Chief complaint, pain in abdomen and loss of weight for last two months. At that time patient began to have sharp pain in the upper part of the abdomen and on the left side. Frequently this pain would come on shortly after eating. Nauseated but seldom actually vomited. These symptoms have become increasingly severe. She derived some benefit, but had lost 20 pounds. Physical examination showed tenderness in the epigastrium, but no palpable masses. No other abnormalities. Fluoroscopic, combined with röntgenological examination, reveals a distinct hour-glass stomach due to ulceration on the lesser curvature.

Operation, December 30, 1922.—Median incision from ensiform to umbilicus. On opening the abdomen very extensive and broad adhesions were found, running from the free border of the liver to the stomach and from there on to the anterior abdominal wall. The adhesions were so dense and extensive that the whole anterior surface of the stomach, including the gall-bladder, were concealed by them. After freeing the organs from these adhesions it was found that we had to deal with a large hour-glass stomach, caused by a penetrating ulcer, situated half-way between the pylorus and the cardia. Remembering that in hour-glass stomach multiple ulcers in the pyloric region of the stomach often occur, he decided to resect the entire pyloric portion. A resection after Billroth was done.

In his gastro-intestinal work, he was always very much impressed by the difficulty of feeding these patients after the operation. Although he had never hesitated to administer small quantities per mouth as early as four hours after the operation, their suffering from thirst was not materially relieved, as the quantities one dared to give were of necessity small. In a good many cases nausea and vomiting also interfered. hypodermoclysis and Murphy drip do not alleviate the thirst of the patient, who is always more or less dehydrated and emaciated. These methods of artificial feeding often add considerably to the discomfort of the patient, whose nervous system and whose whole constitutional resistance has been severely tried by an operation of such magnitude. He therefore decided to feed these patients immediately, by the introduc-

tion of an Einhorn duodenal tube into the jejunum. This was done in the following manner: After the posterior walls of the stomach and the duodenum were sutured together and before the anterior sutures were introduced, an assistant introduced a stomach tube through the mouth. After the stomach had been emptied of some fluid which had accumulated during the operation, the clamps were removed from the stomach. The tip of the stomach tube was now caught by a pair of forceps and drawn through the wound. An Einhorn tube was now inserted into the eye of the stomach tube and fastened there by a silk suture and both tubes were withdrawn through the mouth. The end of the Einhorn tube was secured to the cheek of the patient and its tip which projected through the stomach wound was guided into the duodenum and pushed down into the jejunum for about two feet.

The anastomosis was now completed and the patient was given immediately one ounce of whiskey and three ounces of water at blood temperature. Four hours after the operation regular two-hourly Einhorn feedings were given with enough water in between the feedings to allay thirst. The tube was withdrawn on the eighth day and a semi-soft diet allowed per mouth. During the whole time the patient felt very well, had no thirst, no vomiting, no nausea, in fact, suffered no inconvenience at all after the operation. The usefulness and simplicity of this method of immediate feeding is quite obvious. The first report of the use of this method is by Anderson (*ANNALS OF SURGERY*, May, 1918).

DR. RICHARD LEWISOHN said that in penetrating ulcers of the lesser curvature direct anastomosis (Billroth I) is not difficult if the stomach is freed extensively. It is remarkable to what extent both the stomach and duodenum can be mobilized after careful ligation of the vessels. Haberer has performed Billroth I in cases where more than two-thirds of the stomach was removed; yet it was possible to bring the two ends together without tension. Haberer has performed a few hundred Billroth I for gastric and duodenal ulcers with a remarkably low mortality (4 to 5 per cent.).

DR. DEWITT STETTEN spoke of a tendency in Europe to return to the Billroth I type of operation. In addition to Haberer, Schoemaker of the Hague is doing this operation, for which he has devised a special clamp for the resection and reconstruction of the lesser curvature. During the past summer, Doctor Stetten had the opportunity of seeing Schoemaker, with whom he discussed the question and whose statistics he had the opportunity of inspecting. Schoemaker's mortality was about two per cent. It is generally conceded that the functional results after the Billroth II operation have not been entirely satisfactory. Hence the tendency has developed to attempt to reconstruct, as far as possible, the normal anatomical relationship between the stomach and duodenum after resection. Doctor Stetten has been waiting for a case in which to apply the Schoemaker clamp, but has as yet not succeeded in finding one in which he could sufficiently mobilize the stomach for its application. He believes, however, that in suitable cases the Billroth I opera-



## PRIMARY ULCER OF THE JEJUNUM

tion should in some way or another be attempted and that the results ought to be more satisfactory in the end than the usual posterior gastro-enterostomy.

DOCTOR FISCHER, in closing the discussion, said that he showed this case as a successful example of post-operative feeding with the Einhorn duodenal tube, and was sorry that this phase had not brought out some discussion. He has done the Billroth I several times with good results. In this case he had no difficulty at all. It was not necessary to mobilize the duodenum as the parts came together rather easily. There is no doubt that in all those cases where one can establish the outlet of the stomach at the proper physiological point, this method is best.

## PRIMARY ULCER OF THE JEJUNUM

DR. HERMANN FISCHER also presented the case of a female, age forty-two, who entered the Lenox Hill Hospital on May 23, 1922, for the relief of (1) intermittent epigastric pain, (2) dyspnoea, (3) profuse night sweats, and (4) slight hoarseness. Present Illness.—For the past year, over long and irregular periods, the patient has had attacks of tight constricting epigastric pain, originating in the pit of the stomach and radiating along both sides to the back. The attacks of pain last from two hours to five days. No definite relation to meals can be found. No vomiting. During the past two years there has been vertigo, palpitation and chills at irregular times. Her preceding history is quite irrelevant.

Her physical examination was conducted with the utmost care and thoroughness. The only positive findings were occasional extra systoles and a faint systolic murmur at the apex of the heart not transmitted. Red blood-cells, 2,770,000; hæmoglobin, 55 per cent.; white blood-cells, 5000; polymorphonuclears, 76 per cent.; lymphocytes, 24 per cent., no atypical cells; blood-pressure, 110/50; blood, Wassermann, negative to both antigens; blood group, No. 1 (for transfusion); stools, no parasites (guaiac test not done); urine normal. Fluoroscopic, combined with röntgenographic examination, revealed no defects in the outline of the stomach or first portion of the duodenum that would indicate ulceration or malignancy; gall-bladder negative. She remained in the hospital until June 6, about two weeks. She was on soft diet, was kept out of doors in the sunshine as much as possible, and received Bland's pills 2 t.i.d., and Fowler's sol. m.v. t.i.d. a.c. She left feeling improved. A repeated blood count showed practically the hæmoglobin percentage and red blood-cells, and was discharged with the diagnosis of a secondary anæmia of unknown origin.

On August 25, about two months later, she returned complaining of gradually increasing weakness with dizziness, palpitation, dyspnoea, cyanosis and also paleness after exertion. Also had a "light feeling" in head after exertion. Her pain now was in the right loin. This pain was a new development. It originated in the right loin, radiated to the right scapular region and was worse at night. Physical examination as before was almost entirely negative. Three X-ray examinations were made. The first suggested gastropnoia, and a questionable diverticulum

of the sigmoid. The second with a barium clysma raised suspicions of malignancy of the cæcum and the ascending colon by a break in the barium shadow in the ascending colon. The third did not reveal the same deformity, and that diagnosis was recalled. Stools.—Daily examination revealed blood to be present, no parasites. Red blood-cells, 1,600,000; hæmoglobin, 25 per cent. Blood transfusion was done August 27. On discharge the red blood-cells, 2,800,000; hæmoglobin, 34 per cent. Discharged on September 23, improved, with diagnosis unchanged.

During the following month her stools still showed blood, she lost four pounds in weight, had no appetite, no pain, and her anæmia increased. She was advised to return, and on October 4 was admitted to the surgical ward on Doctor Fischer's service. On October 8 she was transfused with 550 c.c. of blood. The next day an exploratory laparotomy was done by Doctor Fischer.

*Operative Procedure.*—A long median incision from ensiform almost to pubes was made. The exploration of the large gut, stomach, gall-bladder and other organs revealed no macroscopic pathology. At the duodeno-jejunal junction an induration of the wall of the jejunum was found, about the size of a quarter. The wall of the gut was irregular, very much thickened and œdematous. The serosa of the intestine was scarlet red and covered with a few flakes of fibrin. This œdema and inflammatory thickening was also noted in the root of the mesentery and above the intestine in the mesocolon. The retroperitoneal portion of the duodenum was also implicated in the process. The diagnosis of a primary ulcer of the jejunum was made and it was decided to do a retrocolic duodeno-jejunostomy. The descending portion of the duodenum was mobilized after Kocher, pulled through a hole in the mesocolon and anastomosed with the jejunum about 25 cm. below the seat of the ulcer. During the first forty-eight hours there was considerable vomiting which was finally relieved by gastric lavage, thereafter a smooth convalescence. She still has blood in her stools. Blood examination showed the following: Red blood-cells, 2,560,000; hæmoglobin, 35 per cent.; at her reëxamination on February 11, 1923, but all her pain and discomfort and the anorexia from which she suffered have disappeared. She has gained about ten pounds.

DR. WILLIAM A. DOWNES said he would be interested in the future of this case. In doing an exploratory operation recently he had the misfortune to overlook an early carcinoma of the jejunum. The growth was about three inches beyond the duodeno-jejunal angle. The patient later returned and died in the hospital. This growth was found at autopsy. Symptoms were those of hemorrhage. When indicated duodeno-jejunostomy is an operation of great value.

DR. DEWITT STETTEN had seen an autopsy in a case similar to the one mentioned by Doctor Downes. The patient had been slightly jaundiced and had been turned over to him for operation, with the diagnosis of either duodenal ulcer or cholelithiasis. The night before the patient was to be

### PULMONARY LIP FISTULA

operated on, he had a very severe gastric and intestinal hemorrhage. The operation was postponed. Unfortunately, this was before the days when transfusion was commonly practiced. The patient, on the following day, had another very severe hemorrhage and died before anything could be done. Autopsy showed an extensive carcinoma of the transverse portion of the duodenum extending up to the duodeno-jejunal junction. Doctor Stetten feels that possibly Doctor Fischer's patient may be suffering from a similar condition in spite of the temporary improvement after the duodeno-jejunostomy.

DOCTOR FISCHER, in closing, said that he did not consider this patient cured. She still has small amounts of blood. But her hæmoglobin is 35 per cent. and she has gained ten pounds in weight, so she is improved. He was not sure of the non-malignancy of the condition in this case, although its appearance was that of a simple ulcer.

### PULMONARY LIP FISTULA

DR. WILLY MEYER showed a man who had been well until twenty-four years of age when, without any apparent reason, without having passed through a nasopharyngeal operation, pneumonia or influenza, he developed a lung suppuration of intense character with extremely foul and massive sputum, and was declared to be tubercular. He went to the mountains for a long time. There he developed an external abscess which was opened. Conditions did not improve. He came under the reporter's care in the fall of 1916, much run down and daily expectorating large amounts of foul sputum. Under local anæsthesia a piece of rib was resected, establishing better drainage. The exploring finger entered a large and deep cavity within the lung. Having seen lasting benefit result from prolonged drainage and thorough ventilation, the skin was stitched to the borders of the opened lung in order to produce a lung lip (pulmonary lip) fistula. The patient continued to expectorate large amounts of sputum for a little while. He was given oxygen inhalation through the wound and made to breathe through it. About two weeks after the operation, the odor had completely disappeared. The left arm, that had become tied down to the chest by the inflammation of the pectoral muscles in consequence of the extra-pleural suppuration, had been freed by dividing the muscles at right angles to their fibres during the operation. Now he has what one might well call "a burned-out crater" in the lung; the probe goes down for three inches into a large irregular cavity, wide open in all directions. He has no more expectoration and is well and happy, holds an important position, rides the bicycle and plays tennis. I advised him to be careful not to take a full bath; but recently he forgot this and while in the bathtub leaned back and the cavity filled with water. He leaned sideways quickly and the water ran out.

The case represents a principle. It proves that in these extremely run-down patients who cannot stand lobectomy one can still help by

## NEW YORK SURGICAL SOCIETY

making a thorough incision and unobstructed drainage with ventilation of the lung to the surface, not allowing the wound to heal by letting scar form around the opening (lip fistula). This patient is entirely well six and a half years after the operation and has full use of his arm. Lately he developed a slight hemorrhage through the wound subsequent to mental excitement. Direct inspection with the thoracoscope (pulmonoscope) shows below a projecting portion of the irregular crater a whitish crust, evidently adherent to an ulcerated surface, the other parts of the cavity being healthy, moist and glistening.

### SARCOMA OF THE CLAVICLE

DR. JOHN F. ERDMANN reported a case of sarcoma of the clavicle, a male, sixty years of age, who was struck on the left clavicle by a flying piece of machinery about the latter part of September, 1922. The patient was observed for a period of thirteen to fourteen weeks. When he came to Doctor Erdmann's service at the Post-Graduate Hospital, he presented a tumor about the size of a small peach in the mid-portion of the clavicle, extending downwards and upwards each way about two to three fingers' breadth. The doctor who was in attendance aspirated the tumor, thinking that it was a hæmatoma. Nothing but blood was found. Close examination presented no cells of a malignant nature. Observation was made for another week, during which time the growth increased in size. An X-ray showed a multi-fracture with a question of osteosarcoma. The second, much clearer X-ray within a week, presented all of the evidences of osteosarcoma. A complete enucleation of the clavicle was done January 13. At the present time, February 14, the wound is thoroughly healed and the patient has practically complete function. Pathological report is that of cystoblastic sarcoma. Doctor Erdmann states that this is the second sarcoma of the clavicle which he has removed in a period of five years. The first was a patient twenty-one years of age.

DR. FRANK S. MATHEWS said he had recently removed a clavicle for a solid central tumor of its outer end, which had not broken through its bony capsule. The pathological report was myeloma; there was no evidence at the time, however, of its being the well-known generalized myeloma. Six months after the operation the patient developed multiple tumors in the skull, the opposite clavicle and humerus, and died. The case was unlike ordinary bone sarcoma in that the recurrence selected bone rather than lung.

DOCTOR ERDMANN, in closing, said that he expected to use radium and X-ray in this case but did not know what good would be obtained from it. He feared there was something more than adhesive or cohesive there. No consideration had been given to the use of Coley's serum on account of the findings.



## ISCHÆMIC FAT NECROSIS

## ISCHÆMIC FAT NECROSIS

DR. CHARLES E. FARR read a paper with the above title, for which see page 513, *ANNALS OF SURGERY*, vol. lxxvii.

DR. BURTON J. LEE said that there had been five cases of traumatic fat necrosis of the breast in five years at the Memorial Hospital. The first had a complete amputation for supposed carcinoma, but no carcinoma was present in the pathological specimen. There are always giant cells and large syncytial cells lining the large spaces containing confluent fat. Having encountered this first case, Doctor Adair and he were on the lookout for others, and during the last four years had encountered four other examples of this condition. In all there was a definite history of trauma. Three had had a hypodermoclysis beneath the breast and the tumor was located at this site. More recently a few surgeons had sent the speaker reports of other cases. Doctor Bloodgood had a case in which amputation had been done for carcinoma, which showed the typical picture of traumatic fat necrosis. Up to the present time there are eight cases which are definitely proven to be traumatic fat necrosis. In the Breast Clinic at Memorial Hospital the percentage of traumatic fat necrosis to primary carcinoma of the breast is four per cent. Doctor Lee believes that a more thorough pathological search will not infrequently show a small proportion of presumable carcinomata of the breast to be really cases of traumatic fat necrosis.

DR. DEWITT STETTEN said that the matter of fat necrosis was first called to his attention shortly after the appearance of Doctor Lee's paper by a woman who had a typical breast tumor with puckering and adherence of the skin. There was an indefinite history of trauma. The skin was slightly reddened and had an infiltrated appearance, which, however, is not infrequently seen in carcinoma. With Doctor Lee's paper fresh in his mind, he excised this tumor for examination, and it was found to be a mass of infiltrated fat having the appearance of having been hardened in formalin. The microscopical examination showed it to be a traumatic fat necrosis. Shortly after this experience he saw another case of a tumor in the femoral region which was variously diagnosed as neoplasm, femoral lymphadenitis or saphenous thrombosis. There was no history of antecedent trauma or infection. The mass was excised and found to be a fat necrosis with typical inflammatory reaction, showing numerous foreign-body giant cells. The interesting feature in this case was that after the wound had healed, an indurated reddened area developed at the inner side of the scar. This area eventually opened, exposing a fat slough down to the fascia, in appearance very much like that of the necrosis which has been noted after the subcutaneous injection of salvarsan. Although there was no luetic history and previous Wassermanns had been negative, a later Wassermann was 4 plus and the patient was put on rigid antiluetic treatment, under which the wound finally healed after some eight weeks.



## NEW YORK SURGICAL SOCIETY

DR. ALEXIS V. MOSCHCOWITZ said that he liked the word ischæmic in contradistinction to traumatic fat necrosis. He had seen a few cases, which were due to the too energetic application of ice bags to the abdomen. On operating on them a definite necrosis of fat was found.

DOCTOR FARR, in closing, said that there have been a number of cases of fat necrosis following operation and he has seen cases where the skin and aponeurosis healed, but there was degeneration of the fat, and this is presumably fat necrosis. In preparing this paper the speaker looked up several hundred references and found four or five cases of undoubted traumatic fat necrosis, and found that one man had succeeded in reproducing the condition in a cat.

## CORRESPONDENCE

### TREATMENT OF TRAUMATIC SYNOVITIS

EDITOR ANNALS OF SURGERY:

Sir:

I was greatly interested in Dr. Clarence A. McWilliams' paper in the ANNALS OF SURGERY, vol. lxxvi, No. 6, p. 677, and would like to offer an improvement in the treatment he there advocates which has been found of advantage in a very considerable number of cases by me. I quite agree with him that immobilization, plaster-of-Paris, splints, and even elastic knee-caps, are all an abomination, and relatively noxious in the order named. The point in which I would join issue with him, however, is the question of aspiration. In many cases of hæmarthrosis, I believe aspiration is uncalled for, as long as immobilization is avoided.

I believe two main causes exist for the prolonged convalescence or incapacity, formerly so common in these cases. First, the extreme atrophy of the extensor muscles of the thigh, and secondly, the custom of putting these patients to walk as a first exercise of convalescence. The first of these is efficiently prevented by allowing the patient to make as much active movement as he can without pain. In a word, active mobilization of the joint in bed. The second is avoided by giving the patient a series of exercises of gradually increasing strain, so that he is led by easy stages to indulge in walking and all the other functions of the joint.

The following is a brief outline of the treatment. The patient is put to bed without any confining apparatus, no icebags or local applications of any kind are applied. He is told to extend and flex the knee as much as he can without pain, and as often as he can. The effusion disappears much more rapidly than when confining apparatus or splints are used, and atrophy of the muscles does not appear. Aspiration is only done when, obviously due to rupture of a large vessel, the tension becomes extreme, and if aspiration be done, not immediately, but two or three days after the occurrence of the traumatism, the hemorrhagic effusion does not recur. Pure synovial tension never exceeds the limits of safety, and quickly disappears.

When the fluid has disappeared, generally in the course of a week or so, the patient is directed to sit on the edge of his bed, or on a table, in such a way that his legs dangle, and he is instructed to make flexion and extension movements as often as he can, the latter as forcibly as he can. In a day or two he can do these thousands of times, resting when either tiredness of the muscles (extensors) or the appearance of pain indicates to him to desist. As his power increases, weights of from one to two kilos are attached to his foot to increase the effort, and in about a week more he may be allowed to

## CORRESPONDENCE

put his foot to the ground. Walking at first is done tentatively, and increased as he regains his power, and generally at the end of twenty days from the date of injury he will be up and about all day.

ROBERT E. HALLAHAN, M.D.,  
*Buenos Aires, Argentina.*

## GONOCOCCUS MYOSITIS

EDITOR ANNALS OF SURGERY:

Sir:

In the ANNALS OF SURGERY of December, 1922, there appeared a communication of Wm. J. Fulton, of Baltimore, under the caption "Gonococcus in Arm Abscess." I quote therefrom: "The following case is reported because the appearance of the gonococcus in the ordinary abscess or sinus has been rarely if ever recorded in literature."

I beg leave to submit that I have reported an abscess of the muscle of the arm under the caption "Gonorrhœal Myositis" in The American Journal of the Medical Sciences, July, 1901, citing four other instances of the finding of the gonococcus in the soft parts. Furthermore, in the 6th Ed. Finger (1905), Die Blenorrhœa der Sexual Organe, a description of blennorrhagic myositis is offered with additional cases and commented to be "not altogether a rare complication," in support of which I refer to additional instances of Becker, Decousse and Harris and Haskel, all reported in Jahresb. d. Urogenital Apparat., 1905.

In my own cases as well as the others the gonococcus could not be recovered from the pus upon culture, though in other respects it behaved tintorially Gram-negative and appeared morphologically as does the gonococcus. Doctor Fulton reports like experience.

The foregoing are instances of metastatic infection of the gonococcus. Against these the correspondent's case merits signal consideration as instantancing a cellular abscess "*in loco*" by direct inoculation of the gonococcus.

MARTIN W. WARE, M.D.,  
*New York City.*

## PREVENTION OF FAT NECROSIS IN INCISIONS

EDITOR ANNALS OF SURGERY:

Sir:

In wounds that do not heal by first intention fat necrosis is, in many instances the first phenomenon observed. It is felt that this is the direct cause of failure to obtain primary union, in many cases.

How does fat necrosis occur and what are its consequences? The following statements are evident: (a) fat is seriously traumatized very easily and is inevitably traumatized in all surgical operations; (b) it is the least resistant tissue to infection; (c) has very little power of absorption; (d) hæmatomata are best prevented by close approximation of living tissues; (e) exces-

## CORRESPONDENCE

sive use of ligatures is harmful; (f) healing is retarded by the presence of foreign bodies.

When an incision is made the fat is severed; large blood-vessels are clamped and tied, smaller vessels are controlled by sponge pressure, application of hot wet towels or sponges; retractors, towels or sponges are applied against the layer of fat. When one realizes that fat is constituted of a network of connective tissue holding cells of fat, which are very friable and easily dissolved, it is not difficult to appreciate that a portion of the cut edges of the layer of fat will be dissolved, the amount corresponding to the amount of trauma to which it has been subjected. It is also easily appreciated that oozing of dissolved fat in the wound will continue after the wound is closed, because hæmostasis and trauma have deprived the superficial fat of its vitality. This favors: (a) hemorrhage by greasing the cut ends of the capillaries and smaller blood-vessels; (b) prevents the immediate early healing of the approximated tissues; (c) and causes accumulation of fluid fat and blood at the bottom of the wound. Thus, owing to the low resistance of fat to infection, its poor power of absorption, presence of catgut, moisture and heat, we have an excellent medium for the growth of microorganisms.

In practically all clean cases and in many infected ones fat necrosis can be prevented by the following simple procedure: after muscles and fascias are sutured, the cut edges of the fat from the skin to the fascia are cut with the sharpest knife obtainable, so that a strip of fat of the thickness of about three to five millimetres is cut away as cleanly and rapidly as possible and the wound is immediately closed. In this manner we have shaven off the layer of fat which has been traumatized and infected and we have removed the portion which would have dissolved most easily. In infected cases, the wound after the muscle and fascia are sutured is washed with ether poured freely into it, after which the layer of fat is rapidly shaven away as indicated.

Two interesting facts have been observed after the above procedure: 1st: there is practically no bleeding from the cut edges; 2nd: the cut edges adhere to each other immediately and securely. The fact that there is practically no bleeding after shaving the superficial fat indicates that the portion removed was poorly supplied with blood. The immediate and firm adhesion of the cut edges after shaving of the fat may be practically demonstrated, if one attempts to reopen a wound which has just been closed.

*Conclusions.*—While it cannot be stated that shaving the superficial fat will prevent fat necrosis in all cases, clinical experience in over five hundred cases demonstrates clearly that shaving of the superficial fat immediately previous to closing the skin will prevent fat necrosis in many instances, and therefore increase the number of primary unions in both clean and infected cases. The procedure is simple of execution and does not prolong or complicate the operation.

ANGELO L. SORESI, M.D.,  
New York City.

CORRESPONDENCE

ALUMINUM POTASSIUM NITRATE IN OSTEOMYELITIS

EDITOR ANNALS OF SURGERY:

Sir:

In the ANNALS OF SURGERY, for January, 1923, is an article which makes claims for a double synthetic salt of potassium and aluminum nitrate for use in osteomyelitis. I was instrumental in starting the treatment here in Chicago as far back as September, 1919, and with some colleagues treated several hundred cases. In fact I recognize one of the two pictures as the same used at that time.

I finally discovered the results, as far as I could tell, were the same whether the cases were treated with aluminum and potassium nitrate or potassium nitrate alone, and have given an account of my experience in the Medical Record, December 3, 1921. My belief is confirmed by the analysis made in the A. M. A. Chemical Laboratory, which showed only 2.5 per cent. of the aluminum nitrate.

J. RAWSON PENNINGTON, M.D.,  
*Chicago, Ill.*

To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY  
227-231 S. 6th Street  
Philadelphia, Penna.



## INDEX TO VOLUME LXXVII

### A

- Abdominal Operations, The Significance of Diarrhoea Following, 524.  
 ABELL, IRVIN: Papilloma and Adenoma of Gall-bladder, 276.  
 Abscess, Brain, Its Surgical Pathology and Operative Technic, 508.  
 Abscess of the Lung, 370.  
 Actinomycosis Treated with Copper Sulphate, 618.  
 Adenoma and Papilloma of Gall-bladder, 276.  
 Adrenal, Congenital Hypertrophy of, 759.  
 Aluminum, Potassium Nitrate in Osteomyelitis, 784; In Suppurative Conditions, 38.  
 Anæsthesia, Colonic, 116.  
 Aneurism, Arteriovenous, 235; Ligation of Common Iliac with Fascial Strip for, 630; Popliteal Traumatic, 108; of the Thigh, 383.  
 Anthrax Infections, Treatment of, 263.  
 Appendix and Cæcum in Children, Sliding Hernias of, 438.  
 Appendix Versus the Ureter in Right-sided Abdominal Lesions, 638.  
 Aponeurosis, The Utilization of the External Oblique, in the Radical Cure of Inguinal Hernia, 605.  
 ARCHIBALD, EDWARD: The Surgical Treatment of Unilateral Pulmonary Tuberculosis, 652.  
 Arterial Decortication, 15.  
 Arteriovenous Aneurism, 235.  
 Artery, Thyroid, Ligation of the Inferior, 397.  
 Arthritis and Osteomyelitis, Suppurative, 497.  
 ASHHURST, A. P. C.: Empyema Thoracis, 249.  
 Aspiration Repeated in Traumatic Synovitis, 120.  
 AUCHINCLOSS, HUGH: Abscess of the Lung, 374; Pyoarthrosis of the Knee, 232; Tuberculosis of Chest Wall, 496; Suppurative Arthritis and Osteomyelitis, 497; Transplantation of Tendon, 499.

### B

- BAKER, JAMES N.: The Ureter Versus the Appendix in Right-sided Abdominal Lesions, 638.  
 BARTLETT, WILLARD: Factors of Safety in Thyroid Surgery, 685.  
 BATES, WILLIAM: Hæmolytic Jaundice, Treated by Blood Transfusions, 247.  
 BEER, EDWIN: Fistula Following Nephrectomy for Tuberculosis, 629; Intestinal Obstruction, Chronic Peritonitis and Multiple Serositis, 635; Multiple Bilateral Kidney Abscesses, 762; Splenectomy for Hæmolytic Jaundice, 764; Pyoarthrosis of the Knee, 233; Significance of Diarrhoea Following Abdominal Operations, 524.  
 Benign Tumors of the Stomach, 580.  
 Biceps Flexor Cubiti Tendon, Rupture of, 358.  
 BIDGOOD, CHARLES Y.: Traction Apparatus for Open Reduction of Fractures, 506.  
 Bile, White, in the Common Duct, 281.  
 Biliary Fistula, Chronic, 765.  
 Bladder, Spontaneous Intraperitoneal Rupture of the, 206.  
 BLAIR, VILRAY P.: Ranula, 681.  
 Blood Transfusion, 364, 503: Hæmolytic Jaundice, 247; Followed by Fatal Anaphylactic Reaction, 761.  
 BLOODGOOD, JOSEPH COLT: Bone Tumors, Metastasis to Lungs from a Pure Myxoma, 106.  
 BOLAND, FRANK K.: Spontaneous Hæmatoma in Sarcoma of Kidney, 311.  
 Bone, Frontal, Fracture of, Transplantation of Costal Cartilages for, 115.  
 Bone Graft in Spastic Paralysis, Stabilization of Wrist Joint by, 246.  
 Bone Tumors, Metastasis of Myxoma to Lungs, 106.  
 Bones and Joints, Heliotherapy for Tuberculosis of, 620.  
 Brain Abscess, Its Surgical Pathology and Operative Technic. By Wells P. Eagleton, 508.

## INDEX

Brain Tumors, Operative Removal of, 769.  
 Breast, Teratoid Mixed Tumors of the, 354; Tuberculosis of the, 661; Tumors of the, Innocent and Malignant, 668.  
 BROWN, HENRY P., JR., Empyema Thoracis, 249; Empyema Thoracis, 401.  
 Bucknall's Operation, for Hypospadias, Modification of, 572.  
 BURDICK, CARL G.: Fractures of the Femur in Children, 736.

### C

Cæcum and Appendix in Children, Sliding Hernias of 438.  
 Cæcum, Involvement of the Lymph Glands in Cancer of the, 698.  
 Calculous Cast of Prostate, 381.  
 Calculi, Urinary, The Mechanism of the Formation of the, 210.  
 CALLANDER, C. LATIMER: Arterial Decortication, 15.  
 Cancer of the Cæcum, Involvement of the Lymph Glands, in, 698; of the Larynx, 1; of Prostate, 628; of the Rectum and Sigmoid in Childhood and Adolescence, 711.  
 Carcinoma, Colloid, 90; Œsophagus, Metastases of, 272.  
 Cardiospasm in the Aged, 615.  
 CARTER, BURR N.: Traction Apparatus for Open Reduction of Fractures, 506.  
 Cartilages of the Knee-Joint, Non-operative Treatment of Displaced Semilunar, 729.  
 Cartilage, Transplant of Costal in Rhinoplasty, 116.  
 CHARLTON, PAUL H.: Sarcoma of the Uterus, 476.  
 Chest Wall, Tuberculosis of, 496.  
 Cholangitis, Cholelithiasis and Cholecystitis, 52.  
 Cholecystectomy versus Cholecystostomy, 48.  
 Cholecystitis, Cholangitis and Cholelithiasis, 52.  
 Cholecystostomy versus Cholecystectomy, 48.  
 Cholelithiasis, Cholecystitis and Cholangitis, 52.  
 Clavicle, Sarcoma of the, 778.  
 COLE, WILLIAM: Hyperthyroidism with Associated Diabetes Mellitus, 252.

Colitis, Surgical Treatment of Chronic Ulcerative, 293.  
 Colloid Carcinoma, 90.  
 Colonic Anæsthesia, 116.  
 Costal Cartilages, Transplantation of, for Depressed Fracture of Frontal Bone, 115.  
 CONNORS, JOHN F.: Diverticulitis of Stomach, 233; Arteriovenous Aneurism, 235; Congenital Diaphragmatic Hernia, 725.  
 COPHER, GLOVER H.: Sarcoma of the Omentum, 721.  
 CRAIG, WINCHELL McK.: Involvement of the Lymph Glands in Cancer of the Cæcum, 698.  
 Cyst, Echinococcus, of Liver, 634; of Liver Solitary, 237; Retention, Removal of a, from the Liver, 68.

### D

DAVID, VERNON C.: Sliding Hernias of Cæcum and Appendix in Children, 438.  
 DAVIS, JOHN STAIGE: General Plastic Surgery, 257.  
 Decortication, Arterial, 15.  
 DECOURCY, JOSEPH L.: Ligation of the Inferior Thyroid Artery, 397.  
 DESPARD, D. L.: Empyema Thoracis, 251; Hæmolytic Jaundice, 249.  
 Diabetes Mellitus, Hyperthyroidism with Associated, 252.  
 Diaphragmatic Hernia, Congenital, 725.  
 Diarrhœa Following Abdominal Operations, 524.  
 Dislocation, Anterior, at the Elbow Joint, 612.  
 Dislocation, Recurrent, of Shoulder, 118.  
 Diverticulitis of Stomach, 233.  
 Diverticulum of the Œsophagus, Treatment of, 267; Perforated Meckel's, 622.  
 DORRANCE, GEORGE M.: Heliotherapy for Tuberculosis of Bones and Joints, 622; Hæmolytic Jaundice, 249.  
 DOUGLAS, BEVERLY: Skin Grafting by Exact Pattern, 223.  
 DOUGLAS, JOHN: Benign Tumors of the Stomach, 580; Ligation of Common Iliac with Fascial Strip for Aneurism, 630; Stricture of the Common Biliary Duct, 768; Perforated Duodenal Ulcer and Bleeding Jejunal Ulcer, 754; Perforated Duodenal Ulcer, 755.

# INDEX

DOWD, CHARLES N.: Tuberculous Peritonitis, 632; Echinococcus Cyst of Liver, 634; Intussusception in Adult, Due to Adenoma in Ileum, 633; Relationship Between Intestinal Obstruction, Chronic Peritonitis and Chronic Multiple Serositis, 423.

DOWNES, WILLIAM A.: Hypernephroma of Ovary in a Child, 758; Injuries to the Common Biliary Duct, 767; Perforated Duodenal Ulcer in a Child, 756.

Drainage in Intraabdominal Infection, 558.

Duct, Common, White Bile in the, 281.

Duodenal Ulcer, Perforated 754 and 755. Perforated, in a Child, 756.

Duodenum and Stomach, Recurring Perforations of, 108.

## E

EAGLETON, WELLS, P.: Brain Abscess, Its Surgical Pathology and Operative Technic, 508.

Echinococcus Cyst of Liver, 634.

EGGERS, CARL: Chronic Empyema, 142; Radical Operation for Chronic Empyema, 327 and 375.

EISENDRATH, DANIEL N.: Double Kidney, 450, 531.

Elbow Joint, Anterior Dislocation at the, 612.

ELIASON, E. L.: Subacute Massive Proctitis, 625.

ELIOT, ELLSWORTH, JR.: Removal of Appendix in a Case of Tuberculosis in the Peritoneum, 637.

ELKIN, DAN COLLIER: Tuberculosis of the Breast, 661.

ELSBERG, CHARLES A.: Operative Removal of Brain Tumors, 769.

Embryoma or Sarcoma of the Kidney in Infants, 306.

Empyema, Atypical Chronic, 375; Chronic, 142, 241; Chronic, Radical Operation for, 327 and 375; Thoracis, 249, 401.

Epiphysis of Tibia, Separation of Upper, 485.

ERDMANN, JOHN F.: Sarcoma of the Clavicle, 778.

ERDMAN, SEWARD: Inguinal Hernia in the Male, 171; Transplantation of Tendon; 503.

## F

FARR, CHARLES E.: Ischæmic Fat Necrosis, 513.

Fascial Strip, Use of, for Arterial Ligations, 630.

Fat Necrosis, Ischæmic, 779; in Incisions, Prevention of, 782.

Femur, Abduction Treatment for Fracture of Neck of, 127, in Children, Fractures of the, 736; Pathological Fracture of the Neck of the, Due to Thyroid Metastases, 689.

FISCHER, HERMANN: Immediate Feeding after Resection of Stomach, 773; Primary Ulcer of the Jejunum, 775.

Fistula, Chronic Biliary, 765; Gastrocolic, 433; Pulmonary Lip, 777.

Foot, Radium Burn of, 628.

Fracture-dislocation of Lumbar Vertebrae, 243.

Fracture of Femur, Traction Treatment of, 239; of the Femur in Children, 736; Pathological, of the Neck of the Femur, Due to Thyroid Metastases, 689; of the Skull, 624.

Fractures, Multiple, of the Pelvis, 623; Spiral, 252; Traction Apparatus for Open Reduction of, 506.

FREEMAN, LEONARD: Improved Technic for Gastrectomy and Gastro-enterostomy, 190.

## G

Gall-bladder Disease in Childhood, 587; Papilloma and Adenoma of, 276; Surgery of the, 64.

Gasserian Ganglion, Priority in Extirpation of, 125.

Gastrectomy and Gastro-enterostomy, Improved Technic for, 190.

Gastro-colic Fistula, 433.

Gastro-enterostomy and Gastrectomy, Improved Technic for, 190.

Gastro-jejunostomy for Perforated Gastric and Duodenal Ulcers, 254.

GEISINGER, JOSEPH F.: Reduplication of the Ureter, 563; Spontaneous Intra-peritoneal Rupture of the Bladder, 206.

GIBBON, JOHN: Biliary Fistula, 767; Perforated Duodenal Ulcer in a Child, 757.

GIBSON, ALEXANDER: Separation of Upper Epiphysis of Tibia, 485.

## INDEX

- GILL, A. BRUCE: Heliotherapy for Tuberculosis of Bones and Joints, 620.  
 Glands, Involvement of the Lymph, in Cancer of the Cæcum, 698.  
 Gonococcus Myositis, 782.  
 Grafting, Skin, by Exact Pattern, 223.  
 GRAHAM, DOUGLAS: Non-operative Treatment of Displaced Semilunar Cartilages of the Knee-joint, 729.  
 GREEN, NATHAN W.: Abscess of the Lung, 370; Radical Operation for Chronic Empyema, 375.  
 GUTHRIE, DONALD: Practical Hospital Psychology, 112.

### H

- Hæmatoma, Spontaneous, in Sarcoma of Kidney, 311.  
 Hæmolytic Jaundice, Treated by Blood Transfusions, 247.  
 HALLAHAN, ROBERT E.: Treatment of Traumatic Synovitis, 781.  
 HARTWELL, JOHN A.: Traumatic Arthrosis, 232; Radical Operation for Chronic Empyema, 380; Recurrent Dislocation of Shoulder, 118. Colonic Anæsthesia, 116.  
 HARVEY, SAMUEL CLARK: A Modification of the Operation of Bucknall for Hypospadias, 572; The Regeneration of the Meninges, 129.  
 Heliotherapy for Tuberculosis of Bones and Joints, 620.  
 HELSLEY, GORDON F.: Metastases of Oesophagus Carcinoma, 272.  
 Hernia, Congenital Diaphragmatic, 725; Inguinal, Radical Cure of, 605; Inguinal, in the Male, 171; Massive Ventral, 445.  
 Hernias, Sliding, of Cæcum and Appendix in Children, 438.  
 HEYD, CHARLES G.: Blood Transfusion, 504; Relationship Between Intestinal Obstruction, Chronic Peritonitis and Multiple Serositis, 636.  
 HODGE, EDWARD B.: Empyema Thoracis, 250.  
 Hospital Psychology, Practical, 112.  
 Humerus, Intrauterine, Sarcoma of, 771.  
 Hypernephroma of Ovary in a Child, 758.  
 Hyperthyroidism with Associated Diabetes Mellitus, 252.  
 Hypospadias, A Modification of the Operation of Bucknall for, 572.

### I

- Ileum, Intussusception in Adult, Due to Adenoma in, 633.  
 Ileus, Combination, 594.  
 Iliac Artery, Common, Ligation of, with Fascial Strip for Aneurism, 630.  
 ILLOWAY, HENRY: Priority in the Extirpation of the Gasserian Ganglion, 125.  
 Infection, Intraabdominal Drainage in, 558.  
 Inguinal Hernia in the Male, 171.  
 Inguinal Hernia, Radical Cure of, 605.  
 Intestinal Obstruction, Chronic Peritonitis and Chronic Multiple Serositis, Relationship Between, 423; Due to Chronic Peritonitis, 635.  
 Intestinal Occlusions, The Coincidence of Two, 594.  
 Intraabdominal Infection, Drainage in, 558.  
 Intraperitoneal Rupture, Spontaneous, of the Bladder, 206.  
 Intussusception in Adult, due to Adenoma in Ileum, 633.  
 Ischæmic Fat Necrosis, 513.  
 IVY, ROBERT H.: Actinomycosis Treated with Copper Sulphate, 618.

### J

- JACKSON, CHEVALIER: Cancer of the Larynx, 1.  
 Jaundice, Hæmolytic, Treated by Blood Transfusions, 247; Splenectomy for, 764.  
 Jejunal Ulcer, Bleeding and Perforated Duodenal Ulcer, 754.  
 Jejunum, Primary Ulcer of the, 775.  
 Joint, Anterior Dislocation of the Elbow, 612.  
 JONES, JOHN F. X.: Removal of a Retention Cyst from the Liver, 68.  
 JOPSON, JOHN H.: Biliary Fistula, 766; Hæmolytic Jaundice, 249; Empyema Thoracis, 250; Ochsner Treatment in Peritonitis, 194; Perforating Wound of Kidney with Secondary Nephrectomy, 110; Volkmann's Contracture, 244.  
 JUDD, E. STARR: White Bile in the Common Duct, 281.

### K

- KEILLER, V. H.: Lymphangioma of the Neck, 385.

# INDEX

- KELLOGG, EDWARD LELAND: Gall-bladder Disease in Childhood, 587.  
 KEYES, A. BELCHAM: Cholelithiasis Cholecystitis and Cholangitis, 52.  
 KEYSER, LINWOOD D.: The Mechanism of the Formation of Urinary Calculi, 210.  
 Kidney Abscesses, Multiple Bilateral, 762.  
 Kidney, Double, 450, 531; Perforating Wound of, with Secondary Nephrectomy, 110; Sarcoma and Embryoma of the, in Infants, 306; Spontaneous Hematoma in Sarcoma of, 311.  
 KLEINBERG, S.: Spondylolisthesis, 490.  
 Knee-joint, Non-operative Treatment of Displaced Semilunar Cartilages of the, 729; Pyoarthrosis of the, 230.

## L

- LAHEY, FRANK H.: Transplantation of Common Duct Fistula into Duodenum, 767.  
 LAMSON, OTIS F.: Certain Aspects of Surgery of the Gall-bladder, 64.  
 Larynx, Cancer of the, 1.  
 LAWS, GEORGE M.: Hemolytic Jaundice, Treated by Blood Transfusions, 247.  
 LEE, BURTON, J.: Traumatic Fat Necrosis, 779.  
 LEE, W. E.: Fatal Reaction After Blood Transfusion, 761.  
 LEHMAN, EDWIN P.: Peri-arterial Sympathectomy, 30.  
 LEWISOHN, RICHARD: Blood Transfusion, 503; Resection of Stomach for Ulcer, 774.  
 LILIENTHAL, HOWARD: Abscess of the Lung, 373; Bilateral Multiple Kidney Abscesses, 763; Chronic Biliary Fistula, 765; Extrapleural Thoracoplasty for Pulmonary Tuberculosis, 630; Radical Operation for Chronic Empyema, 379; Relationship Between Intestinal Obstruction, Chronic Peritonitis and Multiple Serositis, 636.  
 Limbs, Artificial and Amputation Stumps. By E. Muirhead Little, 511.  
 Liver, Echinococcus Cyst of, 634; Removal of a Retention Cyst from the, 68; Solitary Cyst of, 237.  
 LUDINGTON, NELSON AMOS: Rupture of Biceps Flexor Cubiti Tendon, 358.  
 Lumbar Vertebrae, Fracture-dislocation of, 243.

- Lung, Abscess of the, 370.  
 LYLE, H. H. M.: Radical Operation for Chronic Empyema, 380; Relationship Between Intestinal Obstruction, Chronic Peritonitis and Multiple Serositis, 636.  
 Lymphangioma of the Neck, 385.  
 LYONS, JOHN H.: White Bile in the Common Duct, 281.

## M

- MACCARTY, WILLIAM CARPENTER: Involvement of the Lymph Glands in Cancer of the Cæcum, 698.  
 MANN, FRANK C.: Experimental Production of Peptic Ulcer, 409.  
 MASLAND, HARVEY C.: A Power-Driven To-and-Fro Saw, 122.  
 MATTHEWS FRANK S.: Myeloma of Clavicle, 778.  
 MAURY, JOHN M.: Ureteral Injuries During Pelvic Operations, 314.  
 MAYO, CHARLES H.: Treatment of Diverticulum of the Oesophagus, 267.  
 MCGLENNAN, ALEXIUS: Treatment of Anthrax Infections, 263.  
 McIVER, MONROE ANDERSON: Teratoid Mixed Tumors of the Breast, 354.  
 McKNIGHT, H. A.: Multiple Fractures of the Pelvis, 623; Fracture of the Skull, 624; Perforating Wound of Kidney with Secondary Nephrectomy, 110; Recurring Perforations of Stomach and Duodenum 108.  
 McWILLIAMS, CLARENCE A.: Complete Rhinoplasty by Cartilage Transplant and Pedicled Temporal Forehead Flap, 116; The Efficient Treatment of Acute and Chronic, Simple, Traumatic Synovitis, by Repeated Aspirations and Immediate Active Mobilizations without Splinting, 120; Suppurative Arthritis and Osteomyelitis, 499; Transplantation of Costal Cartilages for Depressed Fracture of Frontal Bone, 115.  
 Meckel's Diverticulum, Perforated, 622.  
 Meninges, The Regeneration of the, 129.  
 MERRILL, WILLIAM JACKSON: Stabilization of Wrist Joint by Bone Graft in Spastic Paralysis, 246.  
 Mesenteric Thrombosis, 299.  
 Metastases of Oesophagus Carcinoma, 272.



# INDEX

- Metastases, Thyroid, Pathological Fracture of the Neck of the Femur, Due to, 689.
- MEYER, WILLY: Abscess of the Lung, 373. Atypical Chronic Empyema, 375; Cancer of Prostate, 628; Radium Burn of Foot, 628; Fistula Following Nephrectomy for Tuberculosis, 629; Extrapleural Thoracoplasty for Pulmonary Tuberculosis, 630; Pulmonary Lipfistula, 777; Radical Operation for Chronic Empyema, 380.
- MITCHELL, JAMES F.: Mesenteric Thrombosis, 299.
- MORRIS, ROBERT T.: Treatment of Traumatic Synovitis, 120.
- MOSCHCOWITZ, ALEXIS V.: Biliary Fistula, 768; Prolapse of the Rectum, Operation for, 770.
- MULLER, GEORGE P.: Carcinoma of the Rectum, 626; Perforated Duodenal Ulcer in a Child, 757; Stricture of the Common Biliary Duct, 768; Results of Operation for Prolapse of the Rectum, 770; Sepsis After Tonsillectomy, 761; Surgical Relations of the Sympathetic Nervous System, 641.
- Myositis, Gonococcus, 782.
- Myxoma, Metastasis to Lungs of a, 106.
- N**
- Neck, Lymphangioma of the, 385.
- Necrosis, Ischaemic Fat, 513.
- Nephrectomy, Secondary in Perforating Wound of Kidney, 110; For Tuberculosis, Fistula Following, 629.
- Nervous System, Sympathetic, Surgical Relations of the, 641.
- NEUHOF, HAROLD: Transplantation of Toe, 228; Pyoarthrosis of the Knee, 230.
- NEW YORK SURGICAL SOCIETY: Transactions of the, 115, 228, 370, 628, 754, 771.
- O**
- Ochsner Treatment in Peritonitis, 194.
- O'CONOR, SIR JOHN: Operating Rooms and Body Warmth of Patients, 123; Gastro-jejunostomy for Perforated Gastric and Duodenal Ulcers, 254.
- O'DAY, J. CHRISTOPHER: Cholecystostomy versus Cholecystectomy, 48.
- Oesophagus Carcinoma, Metastases of, 272.
- Oesophagus, Treatment of Diverticulum of the, 267.
- Omentum, Sarcoma of the, 721.
- Operating Rooms, 123.
- Osteomyelitis and Arthritis, Suppurative, 497; Treatment of, with Aluminum-Potassium Nitrate, 38, 784; Typhoidal, 319; Ovary, Hypernephroma of, in a Child, 758.
- OWEN, HUBLEY R.: Traumatic Popliteal Aneurism, 108.
- P**
- Papilloma and Adenoma of Gall-bladder, 276.
- Paralysis, Spastic, Stabilization of Wrist Joint by Bone Graft in, 246.
- PARHAM, DUNCAN: Colloid Carcinoma, 90.
- PECK, CHARLES H.: Abscesses of Kidney, 763; Splenectomy in Haemolytic Jaundice, 765.
- Pelvic Operations, Ureteral Injuries During, 314.
- Pelvis, Multiple Fractures of the, 623.
- PENNINGTON, J. RAWSON: Aluminum-Potassium Nitrate in Osteomyelitis, 784.
- PEPPER, O. H. P.: Haemolytic Jaundice of the Hayem Widal Type, 248.
- Peptic Ulcer, Experimental Production of, 409.
- Perforations, Recurring, of Stomach and Duodenum, 108.
- Peri-arterial Sympathectomy, 30.
- Pericarditis, Suppurative, 236.
- Peritonitis, Chronic, Causing Intestinal Obstruction, 635; Intestinal Obstruction and Chronic Multiple Serositis, Relationship Between, 423; Ochsner, Treatment in, 194; Tuberculous, 632.
- PETERSON, EDWARD W.: Blood Transfusion, 364, 503; Sepsis Following Tonsillectomy, 760; Suppurative Pericarditis, 236; Solitary Cyst of Liver, 237.
- PFEIFFER, DAMON B.: Ochsner Treatment in Peritonitis, 194; Perforated Meckel's Diverticulum, 622; Subacute Massive Proctitis, 626.
- PHIFER, CHARLES HERBERT: Cancer of the Rectum and Sigmoid in Childhood and Adolescence, 711.

# INDEX

## PHILADELPHIA ACADEMY OF SURGERY:

- Transactions of the, 108, 228, 618, 754.
- Plastic Surgery, General, 257.
- PAUL, EUGENE H.: Gastro-enterostomy in Cases of Perforated Duodenal Ulcer, 757.
- Popliteal Traumatic Aneurism, 108.
- PRATT, GEORGE P.: Gastro-colic Fistula, 433.
- PRIMROSE, ALEXANDER: Tumors of the Breast, Innocent and Malignant, 668.
- Proctitis, Subacute Massive, 625.
- Prostate, Cancer of, 628; Calculous Cast of, 381.
- Psychology, Practical Hospital, 112.
- Pulmonary Lip-fistula, 777.
- Pulmonary Tuberculosis, Unilateral, The Surgical Treatment of, 652.
- Pyoarthrosis of the Knee, 230.

## R

- Radium Burn of Foot, 628.
- Ranula, 681.
- Rectum and Sigmoid, Cancer of the, In Childhood and Adolescence, 711.
- Rectum Prolapsed, Operation for, 770.
- Rectus Muscle, Transposition of the, In the Radical Cure of Inguinal Hernia, 605.
- Reduplication of the Ureter, 563.
- REEL, PHILIP J.: Sarcoma of the Uterus, 476.
- Rhinoplasty by Cartilage Transplant and Pedicled Temporal Forehead Flap, 116.
- RIXFORD, EMMET: Spiral Fractures, 252.
- ROBERTS, JOHN B.: Empyema Thoracis, 250.
- ROBINS, CHARLES R.: Sarcoma and Embryoma of the Kidney in Infants, 306.
- ROBINSON, WILLIAM T.: Congenital Diaphragmatic Hernia, 725.
- RODMAN, J. S.: Empyema Thoracis, 251; Operative Removal of Brain Tumors, 770.
- ROTHSCHILD, NORMAN S.: Chronic Empyema, 241.
- Rupture of Biceps Flexor Cubiti Tendon, 358; Spontaneous Intraperitoneal, of the Bladder, 206.
- RYAN WILLIAM JOHN: Intrauterine Sarcoma of Humerus, 771.

## S

- Sarcoma of Clavicle, 778; or Embryoma of the Kidney in Infants, 306; of Kidney, Spontaneous Hæmatoma in, 311; of the Omentum, 721; of the Uterus, 476.
- Saw, Power-Driven To-and-Fro, 122.
- SAYAD, WILLIAM Y.: The Regeneration of the Meninges, 129.
- SCHLAEFFER, KARL: Combination Ileus, or the Coincidence of Two Intestinal Occlusions, 594.
- SCHLEY, WINFIELD SCOTT: Transposition of the Rectus Muscle and the Utilization of the External Oblique Aponeurosis in the Radical Cure of Inguinal Hernia, 605.
- Semilunar Cartilages, Displaced, of the Knee-joint, Non-operative Treatment of, 729.
- Serositis, Chronic Multiple, Relationship Between Intestinal Obstruction, Chronic Peritonitis and, 423.
- Serositis, Multiple, 635.
- SHERWOOD, WALTER A.: Intrauterine Periosteal Sarcoma of the Humerus 771.
- Shoulder, Recurrent Dislocation of, 118.
- Sigmoid and Rectum, Cancer of the, In Childhood and Adolescence, 711.
- SIRIS, IRWIN E.: Fractures of the Femur in Children, 736.
- Skin Grafting by Exact Pattern, 223.
- Skull, Fracture of the, 624.
- SORESI, ANGELO, L.: Prevention of Fat Necrosis in Incisions, 782.
- SPEESE, JOHN: Congenital Bilateral Hyperplasia of Adrenals, 759.
- Spleen, Stab Wound of, 370.
- Splenectomy for Hæmolytic Jaundice, 764.
- Spondylolisthesis, 490.
- STETTEN, DEWITT: Calculous Cast of Prostate, 381; Resection of Stomach for Ulcer, 774; Traumatic Fat Necrosis, 779; Stab Wound of Spleen, 370.
- Stomach, Benign Tumors of the, 580; and Duodenum, Recurring Perforations of, 108; Diverticulitis of, 233; Resection of, Immediate Feeding After, 773.
- STONE, HARVEY B.: Surgical Treatment of Chronic Ulcerative Colitis, 293.
- Stumps, Amputation and Artificial Limbs. By E. Muirhead Little, 511.

## INDEX

Surgery, General Plastic, 257.  
 Surgery of the Gall-bladder, 64.  
 Surgical Treatment of Chronic Ulcerative Colitis, 293.  
 Suppurative Pericarditis, 236.  
 Suspension and Traction Treatment of Fractures, 238.  
 SUTTON, IRWIN C.: Hyperthyroidism with Associated Diabetes Mellitus, 252.  
 Sympathectomy, Peri-arterial, 30.  
 Sympathetic Nervous System, Surgical Relations of the, 641.  
 Synovitis, Traumatic, The Treatment of Acute and Chronic, 120, 781.

### T

TEES, FREDERICK J.: Anterior Dislocation of the Elbow Joint, 612.  
 Tendon, Transplantation of, 499.  
 Teratoid Mixed Tumors of the Breast, 354.  
 Thigh, Aneurism of the, 383.  
 THOMAS, T. TURNER: Empyema Thoracis, 250.  
 THOMPSON, JAMES E.: Lymphangioma of the Neck, 385.  
 Thoracis, Empyema, 249, 401.  
 Thoracoplasty, Extrapleural for Pulmonary Tuberculosis, 630.  
 THOREK, MAX: Aluminum-Potassium Nitrate in the Treatment of Suppurative Conditions, Particularly Osteomyelitis, 38.  
 Thrombosis, Mesenteric, 299.  
 Thyroid Artery, Ligation of the Inferior, 397.  
 Thyroid Metastases, Pathological Fracture of the Neck of the Femur, Due to, 689.  
 Thyroid Surgery, Factors of Safety in, 685.  
 Tibia, Separation of Upper Epiphysis of, 485.  
 Toe, Transplantation of, 228.  
 Tonsillectomy, with Septic Sequelæ, 760.  
 TORRANCE, GASTON: Aneurism of the Thigh, 383.  
 Traction and Suspension Treatment of Fractures, 238.  
 Transfusion, Blood, 364, 503.  
 Traumatic Popliteal Aneurism, 108.  
 Traumatic Synovitis, The Treatment of Acute and Chronic, 120.

Tuberculosis of Bones and Joints, Heliotherapy for, 620; of the Breast, 661; of Chest Wall, 496; Fistula Following Nephrectomy for, 629; Pulmonary, Extrapleural Thoracoplasty for, 630; Unilateral Pulmonary, The Surgical Treatment of, 652.  
 Tuberculous Peritonitis, 632.  
 Tumors, Bone, Metastasis to Lungs from a Pure Myxoma, 106.  
 Tumors of the Breast, Innocent and Malignant, 668; Benign, of the Stomach, 580; Teratoid Mixed, of the Breast, 354.  
 Typhoidal Osteomyelitis, 319.

### U

Ulcer, Peptic, Experimental Production of 409, Perforated Duodenal, in a Child, 756; Perforated Duodenal and Bleeding Jejunal Ulcer, 754.  
 Ulcers, Gastro-jejunostomy for Perforated Gastric and Duodenal, 254.  
 Unilateral Pulmonary Tuberculosis, The Surgical Treatment of, 652.  
 Ureter Versus the Appendix in Right-sided Abdominal Lesions, 638.  
 Ureter, Reduplication of the, 563.  
 Ureteral Injuries during Pelvic Operations, 314.  
 Urinary Calculi, The Mechanism of the Formation of the, 210.  
 Uterus, Sarcoma of the, 476.

### V

Ventral Massive Hernia, 445.  
 Vertebrae, Lumbar, Fracture-dislocation of, 243.  
 Volkmann's Contracture, 244.  
 VILLARS, HORACE S.: Massive Ventral Hernia, 445.

### W

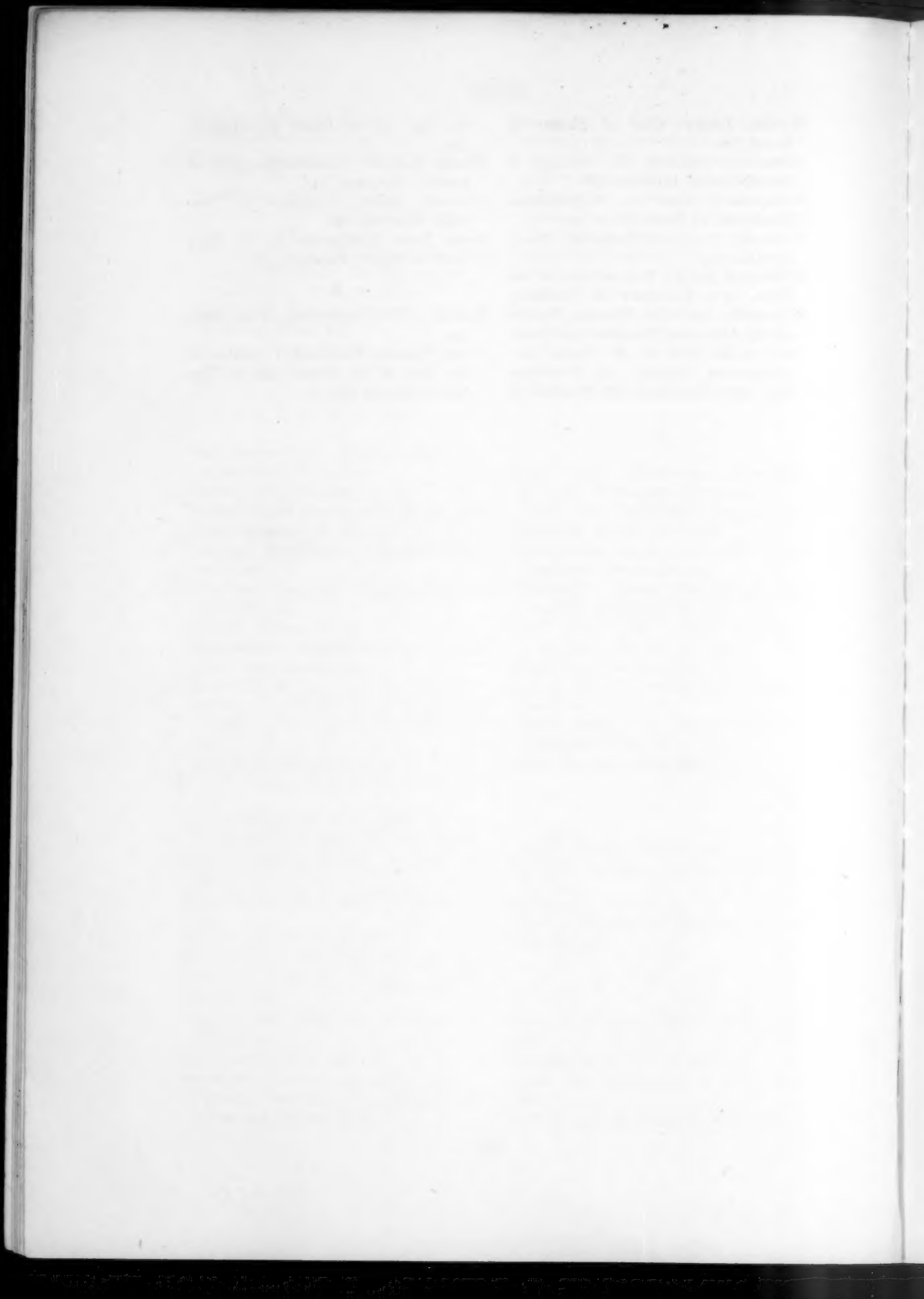
WARE, MARTIN A.: Gonococcus Myositis, 782.  
 WHIPPLE, ALLEN O.: Pyoarthrosis of the Knee, 232; Tuberculosis of Chest Wall, 497.  
 White Bile in the Common Duct, 281.

## INDEX

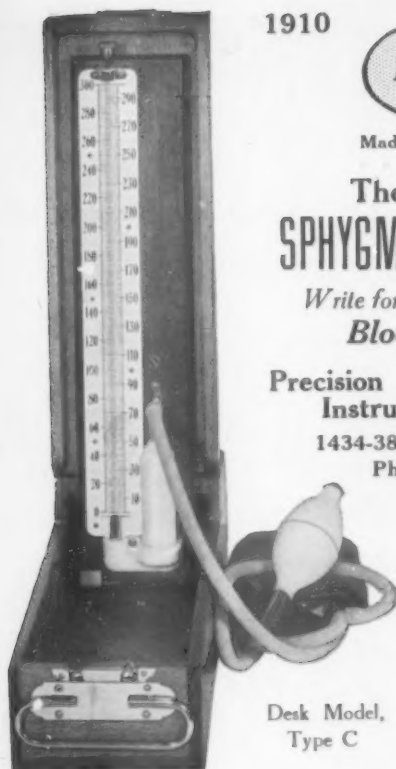
- WIENER, JOSEPH: Cure of Sinuses by X-ray, 629.
- WILENSKY, ABRAHAM O.: Drainage in Intraabdominal Infection, 558.
- WILLIAMSON, CARL S.: Experimental Production of Peptic Ulcer, 409.
- WINSLOW, NATHAN: Typhoidal Osteomyelitis, 319.
- WHITMAN, ROYAL: Pyoarthrosis of the Knee, 232; Treatment of Traumatic Synovitis, 120; The Essential Feature of the Abduction Treatment for Fracture of the Neck of the Femur, 127; Suppurative Arthritis and Osteomyelitis, 499; Treatment of Fracture of the Neck of the Femur by Traction, 239.
- WOLFE, JOHN B.: Fracture-dislocation of Lumbar Vertebrae, 243.
- WOOLSEY, GEORGE: Treatment of Traumatic Synovitis, 120.
- Wrist Joint, Stabilization of, by Bone Graft in Spastic Paralysis, 246.

### Z

- ZAAIJER, J. H.: Cardiospasm in the Aged, 615.
- ZADEK, ISADORE: Pathological Fracture of the Neck of the Femur, due to Thyroid Metastases, 689.







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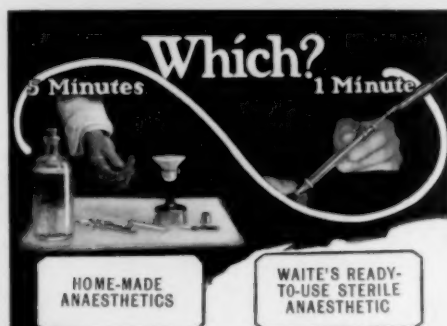
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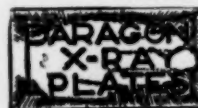
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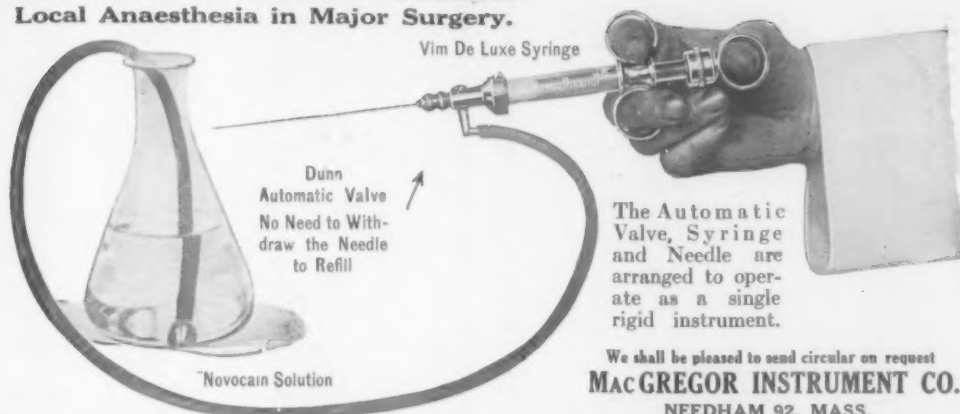
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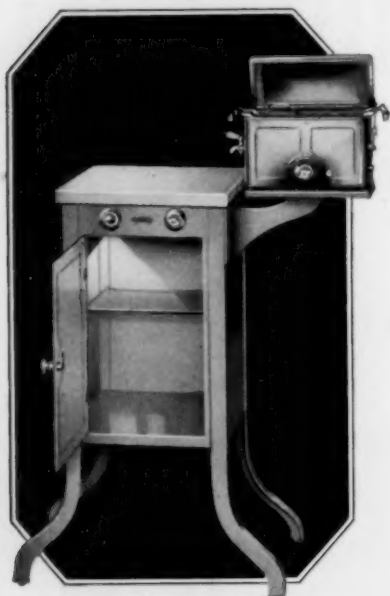
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## INDEX TO ADVERTISERS

(Continued on page 6)

### SURGICAL INSTRUMENTS

	PAGE
Bard-Parker Co. . . . .	3
Harvey R. Pierce Co. . . . .	2
Katherine L. Storm, M.D. . . . .	22
Victor X-Ray Corporation . . . . .	14
Precision Thermometer & Instrument Co. . . . .	17
MacGregor Instrument Co. . . . .	21

### RADIUM

Radium Company of Colorado, Inc. . . . .	5
The Radium Emanation Corp. . . . .	15

### MISCELLANEOUS

Antidolor Mfg. Co. . . . .	20
George R. Fuller Co. . . . .	21
Geo. W. Brady & Co. . . . .	21
A. A. Marks . . . . .	3
The Vitrolite Co. . . . .	11

### FOOD PRODUCTS

Valentine Meat Juice Co. . . . .	Cover
----------------------------------	-------

### HOTELS

The Martinique . . . . .	22
Chalfonte Haddon Hall . . . . .	24
Hotel Morton . . . . .	22
Santa Rita Springs . . . . .	23

### STERILIZERS

Wilmot Castle Co. . . . .	9
The Pelton and Crane Company . . . . .	2
Castle Co. . . . .	9
The Prometheus Electric Company . . . . .	15

### X-RAY PLATES AND APPARATUS

Eastman Kodak Co. . . . .	19
---------------------------	----



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### INDEX TO ADVERTISERS, CONTINUED FROM PAGE 4

PAGE

#### PHARMACEUTICAL SUPPLIES

Lambert Pharmacal Co. . . . .	17
H. A. Metz Laboratories . . . . .	Cover
G. H. Sherman, M.D. . . . .	10
Schering & Glatz . . . . .	18
Fellows Medical Mfg. Co. . . . .	1
Purdue Frederick Co. . . . .	21
New York Intravenous Laboratory . . . . .	4
Parke, Davis & Co. . . . .	12
Farwell & Rhines . . . . .	21
Physicians Supply Co. . . . .	10
Parmele Pharmacal Co. . . . .	Cover
Armour & Co. . . . .	Back Cover
H. K. Mulford Company . . . . .	9
G. J. Wallau . . . . .	6
Abbott Laboratories . . . . .	18
Savory & Moore, Ltd. . . . .	7
Smith, Kline & French Co. . . . .	7
Sharp & Dohme . . . . .	13
The Cilkloid Company . . . . .	Cover

#### LIGATURES

Davis & Geck . . . . .	16
C. DeWitt Lukens Co. . . . .	16

#### SANITARIUMS

Battle Creek Sanitarium . . . . .	23
F. H. Barnes Sanitarium . . . . .	21

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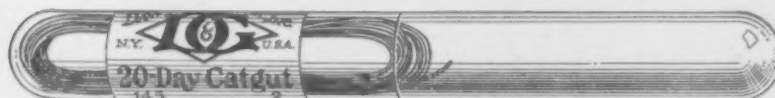


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*Surgical Sutures Exclusively*



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## Claustro-Thermal Catgut Aseptic

**C**LAUSTRO-THERMAL, the improved method of heat sterilization, consists in applying the heat after closure of the tubes, thus avoiding all the chances of accidental contamination.<sup>1</sup> Sterilization by this positive method is made feasible by use of toluol as the tubing fluid, instead of the unstable chloroform.<sup>2</sup>

No other mode of sterilization so completely fulfills the exacting requirements for the production of ideal sutures as does the Claustro-Thermal method. It preserves the natural physical characteristics of the strands, while the destruction of all bacterial life is absolutely assured.<sup>11</sup>

Claustro-Thermal catgut is aseptic though not germicidal. Not being impregnated with any bactericidal substance, it is inert in the tissues, exerting no inhibitive action.

These sutures are boilable. The tubes even may be autoclaved up to 30 pounds pressure for sterilizing their exterior preliminary to use. The heat sterilization procedure is described on the following page.

### VARIETIES OF CLAUSTRO-THERMAL CATGUT

Each Tube Contains Approximately Sixty Inches

Plain Catgut.....	No. 105
10-Day Chromic Catgut.....	No. 125
20-Day Chromic Catgut.....	No. 145
40-Day Chromic Catgut.....	No. 185

SIZES: 000...00...0...1...2...3...4

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

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Kalmerid catgut imbedded in agar infected with *Staphylococcus pyogenes aureus*



Iodized catgut imbedded in the same medium. Note the proximity of colonies

## Kalmerid Catgut Antiseptic

**K**ALMERID CATGUT is an improved germicidal suture superseding iodized catgut.<sup>8</sup> It is not only sterile, but, being impregnated with potassium-mercuric-iodide—a double iodine compound—the sutures exert a local bactericidal action in the tissues.<sup>4</sup> It differs from the Claustro-Thermal catgut only in this respect.<sup>11</sup>

The serious disadvantages of iodized catgut—deterioration, irritation, and impaired tensile strength—have been overcome through the use of potassium-mercuric-iodide instead of iodine. Unlike iodine, it does not break down under the influence of light or heat, it is chemically stable, and it is neither toxic nor irritating to the tissues. It interferes in no way with the absorption of the sutures, and is not precipitated by the proteins of the body fluids.<sup>5,6,7</sup>

These sutures are boilable. The tubes even may be autoclaved up to 30 pounds pressure for sterilizing their exterior preliminary to use. The heat sterilization procedure is described on the following page.

### VARIETIES OF KALMERID CATGUT

Each Tube Contains Approximately Sixty Inches

Plain Catgut.....	No. 1205
10-Day Chromic.....	No. 1225
20-Day Chromic.....	No. 1245
40-Day Chromic.....	No. 1285

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Kalmerid catgut is made also in an extra flexible grade, which is non-boilable, and which is described on the following page.

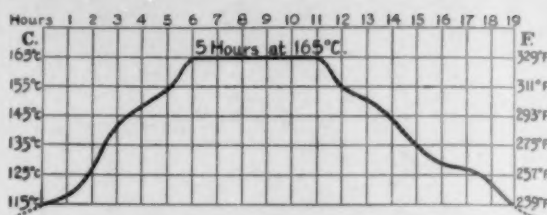
### GERMICIDAL EFFICIENCY AS COMPARED WITH IODIZED CATGUT

The marked inhibitory power of Kalmerid catgut, as compared with iodized sutures, is strikingly shown in these reproductions of culture plates. The lighter areas about the imbedded sutures represent zones of no bacterial growth, while the darker portions are masses of *Staphylococcus* colonies. It is evident that Kalmerid sutures exert in the tissues a far greater antiseptic action than do the usual iodized sutures.<sup>4,7,11</sup>

See Advertisement on Page 16

## Method of Sterilization

**B**OTH Claustro-Thermal and the boilable grade of Kalmerid catgut, described on preceding page, are subjected to the same sterilizing procedure: the sealed tubes are submerged in a bath of cumol and there exposed for five hours to the rigorous temperature of 165° C. (329° F.).<sup>1</sup> It is obvious that sterility is absolutely assured. Rigid bacteriologic control is maintained.



### Kalmerid Catgut—(Non-Boilable Grade) Extra Flexible

**T**HE NON-BOILABLE grade of Kalmerid catgut differs from the boilable variety described on the preceding page in that it possesses extreme flexibility—a characteristic sometimes desired by surgeons accustomed to the use of iodized catgut.<sup>7</sup> It is impregnated with potassium-mercuric-iodide, causing the sutures to exert a local bactericidal action in the tissues.<sup>11</sup>

Potassium-mercuric-iodide is the double salt of iodine and mercury,<sup>6</sup> the chemical formula of which is  $HgI_2 \cdot 2KI$ . Through its use the serious disadvantages of iodized catgut—deterioration, irritation, and impaired tensile strength—have been overcome.<sup>8</sup> It is one of the most active germicides known, exerting a killing action on bacteria about ten times greater than that of iodine.<sup>4,5</sup> Physiologically it is bland and is entirely compatible with the tissues, not being precipitated by the proteins of the body fluids.

#### VARIETIES OF THE NON-BOILABLE GRADE OF KALMERID CATGUT

Each Tube Contains Approximately Sixty Inches

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10-Day Chromic.....Non-Boilable Grade....No. 1425  
20-Day Chromic.....Non-Boilable Grade....No. 1445  
40-Day Chromic.....Non-Boilable Grade....No. 1485

SIZES: 000...00...0...1...2...3...4

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List Price per dozen tubes (in U. S. A.).....\$3

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### Kalmerid Kangaroo Tendons Boilable - Non-Boilable

**K**ALMERID KANGAROO TENDONS are the sutures par excellence for those procedures in which post-operative tension is extreme, or long continued apposition necessary, such as in herniotomy, and in tendon or bone suturing. They are not only sterile, but, in addition, are impregnated with potassium-mercuric-iodide, as in Kalmerid catgut, which enables them to exert a local bactericidal action in the tissues.<sup>3,4,11</sup>

They are genuine kangaroo tendons; they are smooth, straight, of uniform contour, and possess a tensile strength about twice that of catgut.

The tendons are chromicized, and so accurately is the process regulated that each size will maintain apposition in fascia or in tendon for approximately thirty days.<sup>8</sup>

Kalmerid kangaroo tendons are prepared in two grades—boilable and non-boilable. The latter are extremely pliable.<sup>7</sup>

#### VARIETIES AND SIZES

Non-Boilable are Product No. 370

The Boilable are Product No. 380

Each Tube Contains One Tendon  
Lengths Vary From 12 to 20 Inches

SIZES: 0...2...4...6...8...16...24

In packages of twelve tubes of one kind and size

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#### THE PERMEATION OF KALMERID SUTURES BY POTASSIUM-MERCURIC-IODIDE



The lighter shaded specimen is a cross section of a strand of plain Kalmerid catgut, highly magnified.

The darker shaded specimen is a cross section of the same strand reacted upon by ammonium sulphid to precipitate the mercuric element.

The uniform color throughout the darker section shows the thorough permeation by the potassium-mercuric-iodide, the equable distribution of which assures a supply of this germicidal substance in the tissues until the suture is entirely absorbed.

## General Qualities of All D & G Sutures

**T**HE SALIENT FEATURES of all varieties of D & G Sutures are compatibility with the tissues, perfect absorbability, maximum tensile strength,

accuracy of sizes, flexibility, and absolute sterility. They are unaffected by age or light, or by extremes of climatic temperatures.

## Various Non-Absorbable Sutures

Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
350..Celluloid-Linen Thread..60 Inches....	000, 00, 0	
360..Horsehair.....4 28-In. Sutures.....	00	
390..Plain Silkworm Gut.4 14-In. Sutures....	00, 0, 1	
400..Black Silkworm Gut.4 14-In. Sutures....	00, 0, 1	
450..White Twisted Silk....60 In....000, 00, 0, 1, 2, 3		
460..Black Twisted Silk....60 In.....000, 0, 2		
480..White Braided Silk....60 In.....00, 0, 2, 4		
490..Black Braided Silk....60 In.....00, 1, 4		

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

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## Sutures For Minor Surgery

Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
802..Plain Catgut.....20 In....00, 0, 1, 2, 3		
812..10-Day Chromic Catgut..20 In....00, 0, 1, 2, 3		
822..20-Day Chromic Catgut..20 In....00, 0, 1, 2, 3		
862..Horsehair.....2 28-In. Sutures.....00		
872..Plain Silkworm Gut.2 14-In. Sutures.....0		
882..White Twisted Silk.....20 In.....000, 0, 2		

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$1.50

Wholesale discount of 25% allowed on gross or more; carriage paid

## Sutures With Needles

Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
904..Plain Catgut.....20 In....00, 0, 1, 2, 3		
914..10-Day Chromic Catgut..20 In....00, 0, 1, 2, 3		
924..20-Day Chromic Catgut..20 In....00, 0, 1, 2, 3		
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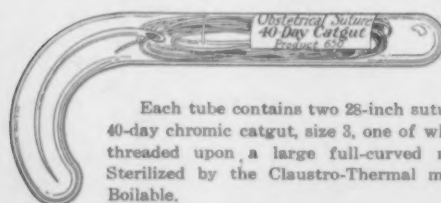
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List Price per dozen tubes (in U. S. A.).....\$3

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Heat Sterilized After Closure of Tubes—Boilable



Each tube contains a 30-inch suture of plain catgut, size 00, threaded upon a small full-curved needle.

In packages of twelve tubes

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Each tube contains two 12-inch ligatures of a specially woven flat tape one-eighth inch wide

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## Standard Sizes For All Sutures

000	_____	IN conformity with the long recognized need for a unified system of sizes, the standard scale of catgut sizes now embraces all sutures, including silk, horsehair, silk-worm gut, celluloid-linen thread, and kangaroo tendons (only the latter occurring in sizes 6, 8, 16, and 24).
00	_____	
0	_____	
1	_____	
2	_____	
3	_____	
4	_____	
6	_____	
8	_____	
16	_____	
24	_____	

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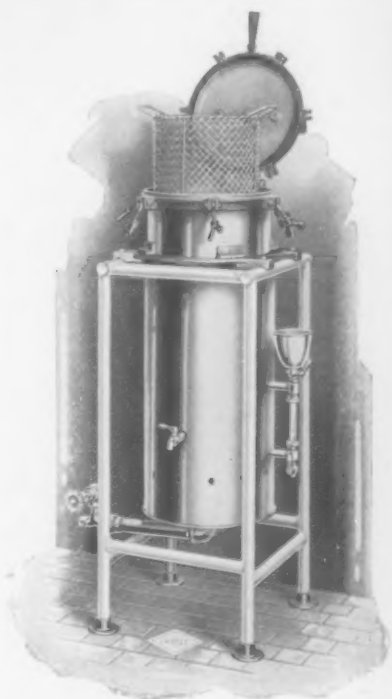
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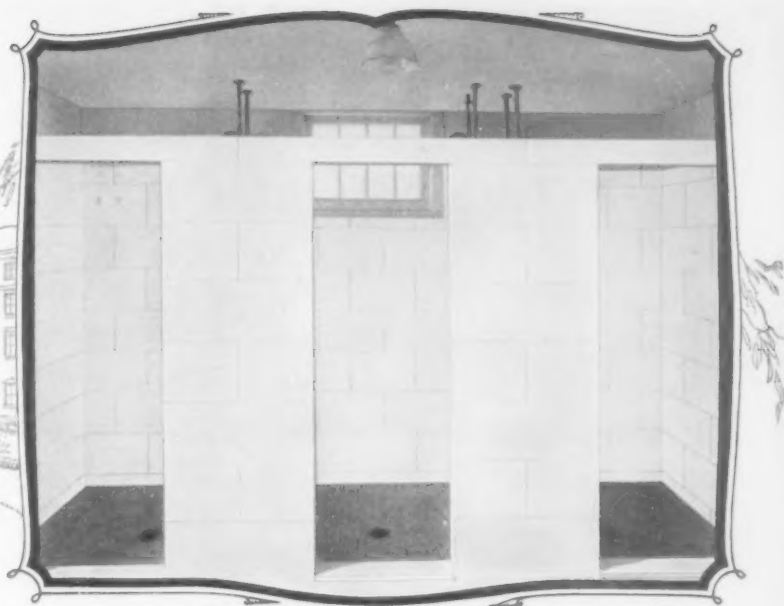
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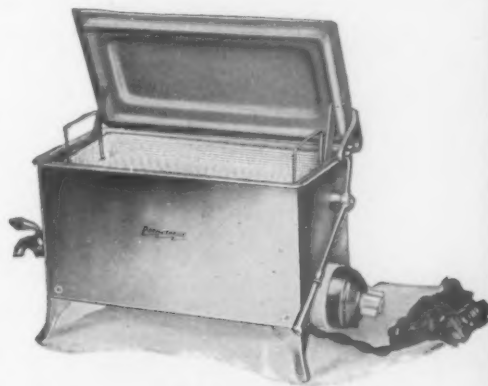
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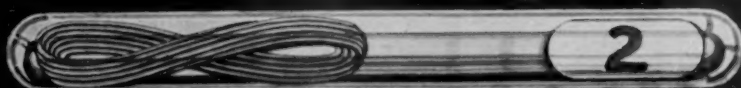
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